DOCUMENT RESUME

ED 097 485 CE 002 252

AUTHOR	Lecht, Leonard A.; And Others
TITLE	A System for Collecting Advance Information on the Character and Extent of Employment Generated by New Government Contracts: Phase II Report.
INSTITUTION	National Planning Association, Washington, D.C.
SPONS AGENCY	Manpower Administration (DOL), Washington, D.C.
PUB DATE	Jun 74
NOTE	231p.; Some of the tables are marginally legible
EDRS PRICE	MF-$0.75 HC-$11.40 PLUS POSTAGE
DESCRIPTORS	Cooperative Planning; Data Analysis; *Data Collection; Employment Opportunities; *Employment Projections; Federal Programs; Job Development; Manpower Needs; *Methods; Models; *Planning; *Prediction; Tables (Data)
IDENTIFIERS	Manpower Planning; *Manpower Research

ABSTRACT

This study was undertaken to develop a model early warning system which could anticipate job openings generated in local communities by large Federal procurement contracts. Among the major findings from the cases studied: (1) projections of job openings were possible in all contracts considered, by the use of estimating techniques which are described in the appendix; (2) the number of job openings generated by the awards were sufficient to be given serious weight in local manpower planning; (3) local manpower agencies, generally aware of the likely employment increase, lacked the detailed occupational information and timing of the employment increase to translate this awareness into program planning; (4) such projections can precipitate a common effort by local manpower officials, company personnel, union officials, and others; (5) job openings estimates, while important, are only one ingredient in local planning, which must also include local labor supply indicators. The first appendix, which takes up about half the document, maps in detail the precise data, methodology, and projection techniques used. The second appendix explains the criteria used in the selection of contract awards to be studied, and the third lists data and data sources used. (NH)

5

ED 097485

A SYSTEM FOR COLLECTING ADVANCE INFORMATION ON THE CHARACTER AND EXTENT OF EMPLOYMENT GENERATED BY NEW GOVERNMENT CONTRACTS

Phase II Report

U S DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

by

Leonard A. Lecht
Marc A. Matland
Richard J. Rosen

National Planning Association

for

Manpower Administration
U.S. Department of Labor

Grant No.21-11-73-34

June 1974

CE 002 252

BEST COPY AVAILABLE

FOREWORD

This is the second report on "A System for Collecting Advance Information on the Character and Extent of Employment Generated by New Government Contracts," a study conducted by the National Planning Association for the Office of Manpower Research, Manpower Administration, United States Department of Labor, pursuant to Research Grant No.21-11-73-34, authorized by Title I of the Manpower Development and Training Act. Since contractors performing research under government sponsorship are encouraged to express their own judgment freely, the report does not necessarily represent the Department's official opinion or policy. Moreover, the contractor is solely responsible for the factual accuracy of all material developed in the report.

TABLE OF CONTENTS

CHAPTER I: Summary 1

CHAPTER II: The Projections of Employment Opportunities 23

CHAPTER III: The Field Experience 57

CHAPTER IV: The Model Early Warning System 75

APPENDIX I: The Methodology 1

APPENDIX II: Selecting the Contracts for Study 106

APPENDIX III: Data and Data Sources for the Three Agencies Studied 117

CHAPTER I

SUMMARY

I.

This report summarizes the National Planning Association's experience in undertaking a series of case studies for the Manpower Administration as a basis for developing an early warning system to anticipate the job openings generated in local communities by large Federal procurement contracts. The first phase of the project, an analysis of a $400 million contract to build nuclear submarines awarded by the Navy to the Electric Boat Division of the General Dynamics Corporation in New London, Connecticut, showed that it was feasible to make these estimates for the large defense contracts exemplified by Navy ship and submarine procurements. The current phase is intended to determine if similar projections can be replicated for large nondefense contracts awarded by different government agencies in widely diverging economic environments.

The project has involved both a research component and a dissemination and follow-up component. The research has been focussed on developing a relatively simple methodology for projecting manpower requirements in individual establishments, identifying data sources, and applying the methodology to the contracts considered in the study. The dissemination component has involved workshops and other meetings with state, local and regional manpower officials, company personnel, union representatives, and others to present the research findings and to facilitate their use in planning training, recruitment and placement activities by local manpower agencies.

The detailed findings in the first phase of the study concentrating on the Electric Boat Division's contract have been presented in an earlier report to the Manpower Administration submitted in October 1972.[1] The present report is concerned with the experience in three other case studies and with the implications of all of the case studies for the establishment of an early warning system. One project selected has involved a $200 million Corps of Engineers civil works contract awarded as a joint venture to three firms headed by the Dravo Corporation for the construction of a lock and dam complex on the Ohio River at Smithland, Kentucky. The second award represents a $200 million grant from the Urban Mass Transportation Administration to the New York City Transit Authority for the purchase of over 700 subway cars from the Pullman-Standard Company in Chicago. The third case study involves two NASA awards to divisions of the Rockwell International Corporation in the Los Angeles area. One involves a $500 million contract for the space shuttle main engine (SSME) awarded to the Rocketdyne Division of Rockwell International. The other consists of a $2.6 billion award to the Rockwell Corporation's Space Division for the development of the space shuttle orbiter.

The overall findings which emerge from the case studies show that:

1. The information base for anticipating the job openings resulting from government contracts extended considerably beyond defense awards. NASA procurement procedures and Corps of Engineers reporting requirements, to cite two instances, provide sources for most of the required data for the contracts funded by the two agencies.

---

[1] A System for Collecting Advance Information on the Character and Extent of Employment Generated by New Government Contracts, Report by the National Planning Association to the Manpower Administration, U.S. Department of Labor, October 1972.

2. It has been possible to devise projections of job openings in all of the contracts considered through the use of estimating techniques relating manpower requirements to the flow of activity in the establishment and then disaggregating the total manpower required into employment in individual occupations.
3. The individual awards have involved a sufficiently large number of job openings to be given serious weight in local manpower planning. The minimum number of job openings anticipated in 1974 for any one of the contracts was the approximately 400 openings listed for the Smithland Dam project. Estimates for the others range up to 5,900 for the Space Division's orbiter project.
4. Local manpower agencies, in the four instances studied, were generally aware through their own efforts of the overall magnitude of the employment increase likely to result from large Federal contracts in their area. However, they lacked the detailed information about the occupations involved or the timing of the employment increase to translate this general awareness into program planning.
5. The dissemination of the job openings projections can precipitate a common effort by local manpower officials, company personnel, union officials, and others to make use of the projections in planning because the projec-

tions provide a detailed quantitative framework concentrating attention on the consequences of the Federal Government's actions which affect them.

6. Estimates of future job openings are only one ingredient, although an important ingredient, in local planning to take account of the consequences of Federal procurements. To receive consideration in planning manpower programs, the projections of job openings must be coordinated with local labor supply indicators, information usually available in state and local Employment Service and MAPC groups.

An operational early warning system could benefit many persons and organizations. The Employment Service could more effectively plan placement and training programs because of the advance notice it would receive of job openings which would frequently figure among the more desirable openings in the local labor market area. By assisting in assuring an adequate supply of workers with the appropriate skills, the system would reduce the likelihood of cost overruns and production delays stemming from manpower bottlenecks in large Federal defense and nondefense contracts. An early warning system could facilitate the Federal Government's equal employment programs by identifying areas for increasing and upgrading job opportunities for women, older workers, or members of minority groups. And, most importantly, wage earners generally would benefit from greater opportunities for employment in industries typically paying better-than-average wages.

The decentralization of manpower program activities to state and local government agencies, as provided for in the Comprehensive Employment and Training Act, increases the importance of an early warning system. The existence of a systematic framework of information about the anticipated consequences of one of the major sources of change in local employment, changes in Federal procurement, can itself provide an important stimulus to reckon with these consequences in local manpower planning. The response to this stimulus is likely to be enhanced if the early warning system includes an active follow-up and technical assistance component as well as a data processing and projections effort.

II.

The projections show that approximately 400 or more new job openings are expected to result from each of the procurement awards considered in the current, the 1974, calendar year. Many of these job openings would represent positions in skilled and semi-skilled blue-collar occupations. The occupational areas with the largest single number of job openings listed for 1974 are assemblers, fitters, wiremen, machinists and machine operators, operating engineers, and engine mechanics and repairmen. Many of the openings represent positions in which individuals can qualify for entry level helper jobs through on-the-job or institutional training programs or for more advanced positions through upgrading training.

The total number of job openings anticipated in 1974 in each of the projects and the leading occupations in which the openings are expected to occur are summarized in Table 1.

Table 1

Job Openings Expected to Result from Large Government Contracts, Selected Firms, 1974

Contract Source and Occupation	Employment Level in December, 1973(1)	Estimated Job Openings in 1974(2)
SMITHLAND DAM:		
All Occupations	693(3)	387(4)
Construction Laborers	247	65
Operating Engineers	60	99
PULLMAN-STANDARD:		
All Occupations	307	897
Fitters	42	190
Joiners	17	105
Machine Operators	31	100
Wiremen	12	205
ROCKWELL INTERNATIONAL:		
Rocketdyne Division:		
All Occupations	3,512	492
Assemblers	158	71
Engine Mechanics and Repairmen	96	56
Space Division:		
All Occupations	10,717	5,950
Assemblers	261	333
Engine Mechanics and Repairmen	189	241
Machinists and Machine Operators	349	446

---

(1) Sources: Unpublished NASA data, company Affirmative Action Plans, unpublished company data, U.S. Census.

(2) NPA estimate.

(3) Estimated average monthly employment, July through December, 1973.

(4) Refers to anticipated job openings in July through December, 1974. No net job openings estimated for first half of 1974.

The job openings estimates for the contracts considered include the increases attributable to growth in employment levels and the additional job openings expected to come about because of deaths, retirements and discharges. In the Pullman-Standard and the Smithland dam projects, virtually all of the employment listed for 1974 was attributable to the specific procurement contracts considered. In the Rocketdyne Division, the SSME project is only one of a number of awards with government agencies, primarily with the Department of Defense, held by that establishment. The job openings listed for 1974 at Rocketdyne refer to those generated by the SSME project. The estimate is net after allowing for employee transfers from other projects. All of the job openings listed for Rockwell's Space Division are expected to result from work on the space orbiter.

The estimates of job openings require interpretation in the light of the economic environment of the firms holding the contracts. For one consideration, the projections refer only to direct employment. Extensive subcontracting characterizes the Pullman-Standard and the Rockwell International awards. This subcontracting can be expected to generate employment in firms supplying complex mechanical, electrical, and electronics systems which probably exceeds the direct employment in the firms producing the end products. Moreover, while the job openings estimates in Table 1 refer to 1974, the projects cover several years and the peak employment levels in each are reached at different times. For instance, the peak production period in the Pullman-Standard contract is expected in the July 1974 through September 1975 period, while the Smithland dam project is expected to reach its maximum level in the second half of 1975 and the SSME project is estimated to attain its maximum employment in 1976.

Projections such as those in Table 1 relating to ongoing Federal contracts should periodically be updated to allow for changes in government work orders and also take into account the shifts in manpower needs because of changes in the occupational composition of the work force in different phases of the project. The job openings listed for the SSME project, for example, are less than half the number initially anticipated because of a stretch-out in the work attributable to reductions in NASA's appropriation. The projections for the Space Division's orbiter project reflect preliminary estimates since the project is still in the design phase. Changes in design could induce changes in concept and focus which would influence the character of the plant work force. Scientists, engineers, and technicians are heavily represented in the work force during this period. Once the transition is made from the design to the production phase, requirements for scientific manpower decline and openings for blue-collar workers come to predominate.

III.

The methodology utilized in preparing the projections has involved the development of a systematic but simple procedure which is replicable in a variety of economic environments and for dissimilar procurement awards. The procedure has been found to be sufficiently flexible to accomodate to the extensive range of data which have been drawn upon in preparing the estimates from many different government and company sources.

The basic projections methodology involves four types of measures. They are:

1. A measure of work load over the life of the award broken down into monthly, semi-annual or annual periods. The work load measure is usually approximated by constant dollar outlays.
2. A manpower coefficient relating the monthly or annual work load to the man-months or man-years of in-plant labor required to produce the output included in the work load.
3. An occupational distribution measure distributing the total manpower requirement in each period into employment levels by occupation.
4. A job openings measure reducing the employment levels anticipated in each period to take account of persons with recall rights to jobs and increasing them to allow for replacement of losses due to deaths, retirements and discharges.

The data needed to prepare these measures can be found in a large number of government and company sources. For example, in planning its programs the Corps of Engineers estimates the overall materials requirements, dollar costs and manpower needs for each component activity of its projects. In all Federally funded construction projects the Davis-Bacon Act requires that payroll data be filed with the appropriate contracting agency including information on wage rates for each employee, hours worked and occupation. In the SSME and orbiter contracts, as in other projects, NASA has prepared "manning curves" indicating the man-years, with some indications of broad occupational categories, required in each fiscal year over the life of the contract. Company officials at the Rocketdyne establishment had prepared estimates of manpower requirements in the SSME project for production workers by department with specific estimates for several craft groups.[2] In the Pullman-Standard award the New York City Transit Authority had charted the anticipated progress payments to be made as work was completed over the life of the contract. This information figures as part of the basis for distributing the work load over time. The range of information found to be available in each of these different contracts strongly suggests that comparable information exists, or could readily be developed, for most large Federal procurement awards, say those of $100 million or more.

The estimating techniques employed in the study are those intended to be useful in focussing on individual establishments, on microanalysis, in a field in which there are well developed macroeconomic techniques concentrating on the impacts of similar changes for the overall economy. The macroeconomic techniques typically make use of some version of input-output analysis including the manpower matrix derived from it.[3]

2/ The estimates for total employment and employment by major category for the space orbiter project have been derived from NASA sources. Due to the late involvement of the Space Division in this study, the distribution of employment by occupation within each major category has relied primarily on industry data with a minimum of company information.

3/ See U.S. Department of Labor, Bureau of Labor Statistics, Patterns of U.S. Economic Growth, Bulletin No.1672, 1970.

These techniques have proven to be highly useful in dealing with aggregative impacts such as the effects of the spending for the space shuttle program in increasing employment on the West Coast, or the consequences of increases or decreases in spending for national defense for nationwide employment and unemployment levels. The macroeconomic techniques possess the additional advantage of making it feasible to prepare estimates of the indirect employment, the employment in the firms supplying inputs to the producers of the end products. They are less useful in dealing with individual economic units such as firms or establishments. The product mix in individual firms will often be more or less different from that of the industry in which they are included in the input-output analysis, they may use more or less advanced or simply different production processes, or the importance of purchases from other firms may vary reflecting the extent of subcontracting or of the integration of processes within the firm. For these reasons, the manpower inputs required per unit of output and the occupational distribution of these inputs in individual establishments will frequently differ from the pattern in the industries most closely related to them.

The differences between establishments and industries in manpower utilization are illustrated by a comparison of the manpower coefficients developed by NPA for the Rocketdyne Division on the basis of current data and the coefficients derived from the value added and manpower data for the industries of which this establishment could be considered a part. The relevant industries were selected from the 1967 Census of Manufacturers and the 1970 Census report on Shipments of Defense Oriented Industries. The comparison is presented in Table 2.

Table 2

Estimated Man-Years of Employment per $1 Million of Value Added, Rockerdyne SSME Project and in Related Industries, Selected Years (in 1974 dollars)(1)

Data Source and Economic Unit	Man-Years per $1 Million of Value Added
SSME Project, NPA Estimate, Fiscal Year 1974	35
Census of Manufacturers, 1967(2) SIC 37226 - R&D in Missiles and Space Vehicle Engines	43
Shipments of Defense-Oriented Industries, 1970(3) SIC 3722 - Shipments of Aircraft Engines and Parts to NASA	49

---

(1) Estimates adjusted to 1974 prices based on unpublished BLS deflator for aircraft and parts industry. A 2.6 percent annual increase in output per man-hour is assumed, based on unpublished BLS estimates of historical productivity changes in the aircraft and parts industry.

(2) U.S. Bureau of the Census, 1967 Census of Manufacturers, 1970, p. 22.

(3) U.S. Bureau of the Census, Current Industrial Reports Series, "Shipments of Defense-Oriented Industries, 1970," 1972, pp.12-13.

The differences in the manpower coefficients are too great to be attributable to the technical limitations in translating all of the estimates to 1974 dollars or in allowing for productivity changes since 1967. The differentials underscore the importance of utilizing specific establishment data as the basis for the projections in the Early Warning System. They also strongly suggest that the projections are likely to be confined to the direct employment in the firms producing the end product or, in very large contracts, to selected major subcontractors.

Preliminary tests of the manpower estimates show that the projections developed on the basis of the establishment manpower coefficients entail a sufficiently narrow margin of error to be useful for manpower planning purposes. For example, the historical man-hours data for the Smithland dam project for each of the months in the first half of 1973 has been compared with the predicted number of man-hours in the same months obtained by applying the manpower coefficients against the actual dollar outlays by month in this period. The average difference per month between the actual and the predicted man-hours amounted to slightly more than 10 percent. For the overall six-month period, many of the monthly differentials cancel out and the difference between the actual and the predicted magnitudes amounted to 2 percent. Tests for individual occupations suggest a margin of error roughly comparable to the estimates for the individual months. These tests show that the projections are of sufficient reliability to be employed for the purpose they are intended, that is, to provide indicators of the magnitudes of job openings by occupation expected to come about from large government contracts in individual firms and communities. With more experience in making use of these or similar estimating techniques, there is a good prospect that the margin of error in the projections could be further reduced.

IV.

The case studies show that the dissemination of the projections of job openings can serve as a catalyst encouraging Employment Service and MAPC personnel, employers, union officials, and others to cooperate in making use of the information in manpower planning. The experience in the case studies also makes it plain that the job openings estimates are only one input in program planning, an input which must be supplemented by knowledge of the local labor supply in the same occupations.

The research findings in the case studies have been disseminated through the medium of one-day workshops attended by Federal, regional, state and local manpower agency personnel, by officials of the employing organizations, by trade union representatives, and by the research staff. It is apparent from the workshops, and from other contacts, that state and local manpower agency officials were generally aware that the contracts under consideration would have important consequences for manpower utilization in their areas. However, this general awareness had not been translated by the local agency personnel into estimates of the job openings expected to come about because of the contract in the next year or two in individual occupations. There was no established local machinery in the instances studied which was specifically concerned with setting in motion the activities which could translate knowledge of the manpower impacts of the contracts into agency program planning.

In the first case study reported on, the Electric Boat Division's award to produce nuclear submarines, the state manpower authorities were reluctant to risk allocating a sizeable share of their total training funds for programs to meet the manpower needs expected to result from this one procurement award. In the case studies in the current phase of the project, the dissemination of the manpower projections and the contacts with the companies and with unions have served to generate interest in using the findings which can reasonably be expected to become translated into program activity. At this time (May 1974), the Pullman-Standard contract represents the most advanced of the awards in terms of making use of the research findings. The presentation of the findings provided the occasion for a workshop hosted by Mr. Samuel Bernstein, Chairman of the Chicago Manpower Area Planning Council and the Mayor's Assistant for Manpower for the City of Chicago. The outcome of the meeting was the establishment of a working committee made up of local manpower agency and company personnel to make use of the projections to develop manpower programs, taking into account the estimated job openings and the availability of qualified individuals in critical occupations in the local labor supply. Over 700 job openings have been identified and listed with the Employment Service and an active recruitment program is now under way. About 500 of these jobs are expected to represent entry level positions. The Employment Service anticipates that approximately 300 of the 700 openings will occur in shortage occupations requiring a special training effort.

In the Smithland dam project, as in most heavy construction activities, the unions are an important link in making use of the early warning information since the unions typically supply the labor to employers. In some instances, the unions involved, for example, the Operating Engineers Union, have conducted manpower training programs supported by Federal funds. The union officials have been concerned that many of their members in Kentucky were unable to obtain more than sporadic part-time employment because of limited work skills. The union, accordingly, was interested in planning for upgrading training programs in the general area rather than simply for employment at the Smithland site. A workshop was held in Louisville, Kentucky in April attended by the Executive Secretary of the State Manpower Council, the State Commissioner of Manpower Services, officials of the Operating Engineers Union, Department of Labor representatives, and the NPA staff. The state officials present indicated an interest in establishing an upgrading training program conducted by the union for union and non-union members focussed on the eastern Kentucky area. It is understood that a proposal to this effect will be submitted shortly.

In the case of the Rocketdyne Division SSME project, the Division suggested that the research and dissemination effort be restructured to take advantage of developments in other parts of the parent organization, Rockwell International. Work on the SSME has proceeded at a slower pace than was initially anticipated because of NASA cutbacks. For this reason, the Rocketdyne officials believe that they will be able to fill their manpower needs from unemployed and underemployed workers with recall rights in the Los Angeles area. It was recommended by the Division representatives that similar projections be prepared for the Space Division of Rockwell International. This Division has received a $2.6 billion contract to build the orbiter for the space shuttle. A workshop was held in the Los Angeles area in April attended by representatives of the city and county manpower planning councils, manpower program operators, local representatives of the NAB program, Department of Labor regional office personnel, officials of the Rocketdyne and Space Divisions of the Rockwell Corporation, and the NPA staff. Although the divisional representatives from Rockwell made it apparent that they are at present able to recruit workers from their recall lists, they expressed a definite interest in using the early warning information to work with the local manpower agencies to increase the representation of minority group employees in their work force, especially in professional, technical, and clerical positions. The space orbiter project is estimated to involve a total of close to 6,000 job openings in 1974. The scale of this project, and the likelihood that openings will develop in some occupations for which workers with recall rights are unavailable, make the project a priority candidate for extended follow-up in an early warning program.

While the job openings projections are an essential ingredient in manpower planning, it is evident that the planning cannot be based on estimates of job openings alone. The significance of the job openings data must be interpreted in the light of the local labor supply in the occupations affected. For instance, the initial reluctance of the Rocketdyne Division to become involved in a planning workshop stemmed from the belief that there were sufficient laid-off workers in the Los Angeles area with the required skills to meet their needs for at least the next year or two. The Pullman-Standard Company's more active interest in developing recruiting and training programs grows out of a shortage of workers with the required skills in the Chicago area, a shortage symbolized by an overall unemployment rate of 3.5 percent in February 1973. The Operating Engineers' interest in developing upgrading training programs grew out of the presence of an excess supply of construction workers whose limited job skills severely restricted their employment opportunities.

State and local manpower agency personnel, including those in the Employment Service and the MAPC, are the ones most familiar with the local manpower supply conditions. They are also the ones who must link the job openings and labor supply information together in seeking to involve individual establishments in training or recruitment programs. The state and local manpower agencies, therefore, have a central role in implementing an early warning system.

V.

The replicability of the procedures employed in preparing the job openings projections in a number of dissimilar Federal procurement awards underscores the basis in experience for establishing an early warning system as an ongoing activity conducted by a unit created for that purpose. The operation of the system will involve a series of processes which are common to different individual efforts attempting to develop information about future job openings to be utilized by state and local manpower agencies in their program activities.

The common processes underlying the Early Warning System are illustrated in Table 3.

Table 3

Processes and Agencies Involved in an Early Warning System

Process	Agencies
1. Supplying input data for projections	Government Agencies; Firms
2. Preparing job openings projections	Early Warning Unit
3. Disseminating projections and providing technical assistance	Early Warning Unit
4. Developing local manpower supply data	Employment Service; MAPC
5. Utilizing information in program activities	Employment Service; MAPC; Firms; Unions
6. Follow-up on uses of information	Early Warning Unit

The critical feature underlying these different processes is the linkage between the research, the development of information, and the utilization of the information in planning program activities. This linkage is responsible for another essential feature, the interdependence of the Federal agencies, i.e., the Early Warning Unit, and the state and local manpower agencies and private employing organizations. The participation of all of these groups is a prerequisite for the program's success.

The sizeable margins of error involved in dealing with small numbers make it evident that the Early Warning System is primarily applicable to large Federal procurement contracts or to grants to state and local governments leading to such contracts. Limitations of resources are likely to lend further support to this anticipation. While size, say a minimum expenditure of $100 million, is one criterion for selecting the contracts to be considered, size alone is an insufficient basis for selection. Since the purpose of the system is to focus on job openings, the awards chosen should be those which will lead to an increasing level of activity in the firms receiving them. The value added concept provides a useful basis for establishing this increase since the bulk of the value added in most industries is made up of employee compensation and benefits. It would be reasonable to expect that the contracts selected would yield an average increase in value added of at least $5 million a year during the period of the contract beyond the level of activity in the establishment in the preceding period. Assuming that two thirds of the value added were made up of employee compensation and benefits amounting to an average of $12,000 per worker, the contracts selected would be those expected to generate increases in employment equivalent to approximately 250 positions or more.

The number of contracts to be processed by the Early Warning Unit would also be influenced by the availability of job openings projections prepared by the firms receiving the contracts. This would reduce the time spent on each contract by the Early Warning Unit, thereby increasing the number of awards which could be investigated. The unit should, therefore, actively seek to enlist the participation of the companies in preparing the job openings information, especially in preparing the detailed occupational breakdowns. However, it can be expected that the Early Warning Unit will itself prepare the job openings projections in most instances. This will often be done to precipitate the cooperation of state-local manpower agencies or of firms in translating the projections into manpower program activities.

The extent to which the Early Warning System information is put to use, and how it is used, will reflect both the work of the unit and conditions in local labor markets. The distribution in emphasis between formal skill training programs and recruitment and placement activities will depend primarily on the availability of workers with the required skills in the local labor supply. Equally important, the success of the system will depend on the degree to which the Early Warning Unit becomes an active force for disseminating the projections and providing technical assistance to the users rather than a passive supplier of information. The dissemination effort is very likely to involve numbers of workshops and other meetings between the producers and consumers of the information. A follow-up program assessing the uses made of the projections, or the reasons why they were not used, is also essential if the information which is to be provided is to meet the requirements of future users.

The potentials of the Early Warning System are illustrated by the Federal government's public works activities. All told, the Federal government's outlays for construction, largely undertaken by private firms, are estimated to amount to over $13 billion in fiscal 1974. The Corps of Engineers alone in that year was financing 39 civil workers projects involving expenditures of $100 million or more. Outlays on seven of these projects are expected to reach at least $400 million. Not all of the Federal government's spending for construction, for civil works or other purposes, will lead to increases in job openings. However, a system for ascertaining which projects will make for increases in job openings, where, and by how much can make a significant contribution to manpower planning and programs in the decade ahead.

CHAPTER II

THE PROJECTIONS OF EMPLOYMENT OPPORTUNITIES

In the Federal procurements analysed in this phase of the study, over 7,500 new job openings, most of them suitable for some form of training or recruitment program, are projected to occur during 1974 at the facilities of the prime contractors. From the experience in these case studies it appears possible to prepare similar projections for most major awards of a contracting agency on a routine basis once the data base and data sources have been identified. Since the contracts studied represent different contracting agencies and different industries, it would appear that such projections could be prepared for other agencies as well. This makes it feasible to establish a program for preparing projections of job opportunities generated by major Federal procurements as a regular, ongoing activity.

The methodological approach used to prepare these projections has many of the same elements as the interindustry approach of the Bureau of Labor Statistics. The BLS effort uses industry-wide data to derive employment-output ratios for translating program expenditures, and the distribution of these expenditures among various industry sectors, into manpower requirements. NPA's approach also constructs an employment-output ratio; however, the ratio is "firm specific" rather than "industry specific." This is necessary since the level of industry detail available for some industries combines firms manufacturing diverse products and the employment data do not reflect the manpower needs of any single firm included in the industry. Even where the products are the same, the manpower requirements at the firm level can be very different than the "average" for the industry due to differences in company policies and production methods, such as the age of the equipment used, company practices relative to subcontracting, etc.

For the same reasons it is necessary to obtain occupational details for the specific firm rather than use an industry-occupational matrix. Consequently, the methodology used in this study relies on such sources as Affirmative Action Plans, contracting agency estimates, and company data to obtain occupational details, supplementing these sources with industry data when needed.

To derive estimates of new job opportunities at the plant, the occupational projections must be reduced to take account of the fact that some of the new jobs may be filled by workers with recall rights. An adjustment should also be made for deaths, retirements and discharges of current employees where these factors will result in a measurable increase in the number of projected new hires.

This approach has the advantage of utilizing work flow data which are consistently found in all procurement programs in essentially the same form, that is, annual or monthly expenditures. This procedure has also been found to be sufficiently flexible to accomodate to the various types and detail of manpower data which are available and to reduce the time and effort required for the preparation of projections.

I. The Preparation of the Projections

In the contracts studied in this project it was found that sufficient expenditure and manpower data were available to permit projections of job opportunities to be prepared far enough in advance to be taken into account in manpower program planning. The projections identified future opportunities for employment in which the number of openings, the occupations involved and the skill levels required appear to warrant some local training, recruitment or other manpower program response. Although the true test of the projections cannot be completed until the projection figures can be compared with future actual employment levels, the methodology produced results which conformed closely to company estimates, where these were available, or to known employment when applied to a prior time period. It is significant that the projections, and the conclusions regarding the need for manpower programs, were considerably different from those which would have been derived from the use of macroeconomic data.

In applying the projection methodology to the awards under study, NPA identified a wide range of data sources and data types. Work flow information can range from projections of annual budget obligations to detailed estimates of future monthly expenditures. The manpower data may contain detailed occupational breakouts, or may be restricted to total "in-house" or direct employment. With some awards all the data can be found within the government, while in other cases the cooperation of the employer may be essential to the collection of the required information.

The Corps of Engineers/Smithland Civil Works Project. In the case of the Corps of Engineers projects it is possible to collect all of the required data within the agency itself. For all major Corps of Engineers projects the contractor is required to provide the Corps with a schedule of work which estimates the percentage of each task or work item (e.g., construction of cofferdam, pouring of concrete, installation of piling, etc.) to be completed for each month during the life of the project and the total cost of each task. The Corps then makes projections of the monthly expenditures of the contractor for budgeting purposes.

In order to translate these estimates of monthly expenditures into projections of employment it is necessary to develop manpower coefficients which relate the number of workers required to perform a given task to the dollar cost. These manpower coefficients can be derived from historical data on similar projects available from the Corps and can serve as a model in relating projected dollar spending by work item to shifts in the size and occupational composition of the project work force.

The historical data on dollar expenditures by task for similar projects are available from work progress reports which are prepared by the resident engineer of the Corps on a monthly basis for each major construction award. These reports contain data on the dollar expenditures and the percentage of each work task completed during the month. The Corps also receives copies of all payrolls for its construction projects under the provisions of the Davis-Bacon Act. These payrolls are required to contain information on the wage rates, hours worked, occupation, etc. for each employee who worked during the reporting period. From these two sources of data it is possible to conduct statistical analyses to determine the relationship between fluctuation in work flow and changes in employment by occupation. For example, manpower coefficients can be derived which indicate the number of carpenters, laborers, operating engineers, etc. required to pour a cubic yard of concrete or move a cubic yard of earth expressed in dollar terms. (For an analysis of the validity of the coefficients, see Appendix I.)

These coefficients may then be applied to the projected expenditures by work task to determine the likely future size and occupational composition of the work force on similar projects at the same stage of development. These projections should be valid even if the level or mix of work tasks varied between the two projects, since the coefficients are related to the work tasks rather than to overall expenditures. This takes into account differences between projects in the relative magnitudes of concrete or excavation work, etc.

Because projects for the Corps of Engineers usually extend for several years and the level of work may vary from the original estimate due to changes in appropriations, neither the Corps of Engineers' projections of monthly earnings nor the contractor's schedule can be taken as fixed beyond the coming fiscal year. This is sufficient, however, for preparing projections of employment up to eighteen months in advance.

The contractor's schedule of work flow indicated that the bulk of the expenditures at the Smithland locks during the next year or so would be devoted to finishing concrete work on the locks, with work on the flooding of the cofferdam and clean-up scheduled for the latter portion of the period. The proportion of each type of work scheduled each month by the contractor was applied to the monthly expenditure forecast by the Corps of Engineers. This provided measures of the dollar expenditure each month of the fiscal year by work item (see Table 4).

From the payrolls and work item expenditures by month for a previous lock project it was determined that, at this stage of completion of a lock, every $1,000 of total expenditures generates 46.2 man-hours of work.

Table 4

Projections of Monthly Expenditures at Smithland by Major Work Item, FY 1974
(thousands of dollars)

Fiscal Year 1974	Projections of Monthly Expenditures	Proportion of Outlays for Major Work Items: Concrete	Miter Gates	Wall Armor	Other
July 1973	$ 3,256.9	80%	0%	13%	7%
August	3,433.7	80	0	13	7
September	3,444.8	80	0	14	6
October	3,300.8	80	0	14	6
November	2,481.8	83	0	15	2
December	1,804.7	66	0	13	21
January 1974	1,553.2	69	0	9	22
February	1,375.6	75	0	10	15
March	1,640.7	64	15	9	12
April	1,183.8	74	18	0	8
May	539.1	79	19	0	2
June	484.2	59	37	0	4
Total Fiscal Year	24,500.0	76	3	12	8

Because of the phase of construction, concrete expenditures accounted for almost all of the employment; 17.3 man-hours of carpenters, 20.9 man-hours of construction laborers, 5.1 man-hours of operating engineers, and 2.6 man-hours of teamsters for every $1,000 spent on concrete pouring. It was also determined that every man-hour of operating engineers required the support of .55 man-hours of oilers/greasers, and .45 man-hours of mechanics. These occupations accounted for the bulk of the employment at the site. The remaining workers were divided among many occupations, including batch plant operators, firemen, welders, cement masons, etc., and professional, administrative and clerical jobs. In each of these cases, the number of workers was too small to warrant separate calculation.

Employment projections were prepared by applying these coefficients to the estimated expenditures by work item shown in Table 4. Projections for the first half of FY 1975 were also prepared using Corps of Engineers preliminary estimates of expenditures for that period. With turnover and shifts in the work force composition resulting from changes in work tasks, there should be almost 400 job openings during calendar 1974.

Aside from some small increases in specialized occupations such as welders, painters, millwrights and electricians who will be needed for the installation of machinery and final touches on the locks, the outlook for the Smithland project through June 1974 indicates a decline in employment as the major work effort on pouring concrete for the locks is completed. Total employment during this period is expected to decline from an average of about 700 workers in the July December 1973 period to under 300 in the following six months.

Beginning in July of 1974, however, while clean-up work will proceed on the locks at a low level, work is expected to begin on the dam itself which should be reflected in major increases in employment. The initial phases of work on the dam, which overlap the final stages of work on the locks, will require a different work force mix, as the dam effort focusses on the construction of a cofferdam while the major lock activities shift from pouring concrete to the removal of the old cofferdam used in constructing the locks (see Table 5).

Table 5

Employment and Job Openings, by Occupation, at Smithland, 1974

	Average Employment			
	Estimated Actual	Projected		Estimated Job Openings (1)
Occupation	July-Dec '73	Jan-June '74	July-Dec '74	in 1974
Total	693	270	634	387
Carpenters	205	71	55	[16]
Teamsters	32	11	49	39
Laborers	247	86	150	65
Operating Engineers	60	22	120	99
Oilers/Greasers	27	10	48	39
Mechanics	33	12	59	48
Others	89	58	153	97

---

(1) Employment increase adjusted for deaths and retirements and refers to job openings in July-December 1974. No net job openings are estimated for the first half of 1974.

Note: Bracketed figure indicates the amount by which lay-offs exceed normal replacement.

The projections indicate that in the second half of 1974 there will be a need for an average of almost 100 additional operating engineers, over 60 laborers, about 45 mechanics, and about 40 teamsters and 40 oilers/greasers.

These occupations, in which increases in employment are projected, are all suitable for some form of manpower program action. In the case of construction laborers, the bulk of the openings are at the entry level, which, nonetheless, requires some short-term training involving personal safety and, in the case of flagmen and laborers performing shoring operations, for example, some skill training. In addition, the laborers also perform in occupations such as driller, powderman and vibrator operator, which require more extensive training. In the case of operating engineers, although a lengthy apprenticeship period is required for full journeyman status, filling apprenticeship opportunities could involve the local Employment Service in recruitment, and pre-apprenticeship training could involve MDTA programs. In addition, many of the journeymen operating engineers can work only on a limited number of machines. This could require the development of upgrading training programs to equip them with the broader range of skills necessary for continued employment at Smithland resulting from the use of different pieces of equipment at different phases of the work. Oilers/greasers and, to a lesser extent, mechanics are also occupations suitable for training.

In all these occupations the construction unions are the primary source of workers and maintain hiring halls for recruiting and referring their members to employers. A review of a sample of the employment records of members of the International Union of Operating Engineers reveals that of the active members of Local 181 (which has jurisdiction in Kentucky) as estimated 916 had limited skills and worked less than the equivalent of thirty weeks in union construction employment during 1973 According to the union, these operating engineers worked less than what the industry considers full-time and could improve their employability through upgrading training.

The pension fund records of the union show the number of weeks of work for each of the members of Local 181, about 1,350 of whom were active members who worked less than the equivalent of thirty weeks on union construction jobs during 1973. In order to determine if local union employment records could provide the necessary information to identify likely candidates for upgrading training, NPA selected the 391 union members who worked between ten and twenty weeks for intensive review.

The local union records contained detailed information for 340 union members in this group. Table 6 shows that of these Local 181 members, there were 152 under the age of fifty and 80 fifty years of age or over who were at low skill levels and could benefit from upgrading training. The remainder already appeared to be at high skill levels since they could operate two or more pieces of heavy equipment.

If the proportion of workers at the lower skill levels were applied to all active members of Local 181 who worked less than thirty weeks on union construction jobs during the year, there would be approximately 916 workers who could improve their employability by upgrading their skills of whom 450 would be under the age of fifty and would be particularly suitable candidates for upgrading training programs.

Table 6

Local 181 Members Employed in Union Construction Jobs the Equivalent of Ten to Twenty Weeks During 1973, by Skill

Skill	Workers Under 50 Years of Age	Workers Over 50 Years of Age
High skill level (operate two or more heavy machines)	68	40
Candidates for upgrading	152	80
Misc. light equip. operators	73	34
Oilers/greasers	15	2
Mechanics	4	4
Heavy equip. operators (low skill or operate only one machine)	60	40
Total	220	120

Of those workers who could benefit from upgrading, the light equipment operators include such workers as small compressor and pump operators or welding machine operators. In most cases the work history of these members showed no experience with heavy equipment. A similar situation existed with regard to the oilers/greasers. Although most of these workers would have some familiarity with heavy equipment, they more than likely would need full training programs.

Some of the heavy equipment operators are experienced in only smaller pieces of equipment, for example, tractors, tuggers, or cherry pickers, and require upgrading training in order to prepare them for employment on the larger and more complex equipment. Even some of the more complex heavy equipment operators, such as bulldozer, backhoe, or highlift operators, could also benefit from training, since they are experienced only in a single machine and their employment opportunities are, therefore, limited.

These workers appear to have considerable experience with heavy equipment and might be upgraded in shorter training programs.

Data on anticipated demand for operating engineers in Kentucky over the next few years indicate a need for over 250 new engineers annually stemming from growth and replacement.[1] An opportunity exists, therefore, to prepare underemployed operating engineers for full employment at the desirable well paying jobs offered in the construction industry through upgrading training.

The NASA/Rocketdyne SSME Award. The basic methodology for preparing projections is essentially the same for NASA awards, involving projections of the work level in dollar terms and translating these dollar figures into manpower requirements. Because the procurement and monitoring practices of NASA differ from those of the Corps of Engineers, however, the data base is different. In the case of NASA procurements, data are available within the contracting agency that permit the preparation of projections of total employment at the contractor's establishment. Detailed occupational breakouts, however, are not available from NASA officials, and this information must be assembled from a variety of sources, including Affirmative Action Plans, company estimates, and Census data.

The program managers for NASA are able to provide historical data on "in-house" costs, and man-years of direct and administrative work expended on projects at Rocketdyne from which manpower coefficients can be calculated. In the Rocketdyne case the historical data indicate that every $1 million of expenditures at the plant normally generates employment equal to 21 man-years of direct labor and 16.7 man-years (or 76% of the direct employment) of overhead labor. These coefficients will identify the number of employees in direct work on the awards (e.g., engineering, production, quality control, etc.) and those employed in support positions (e.g., general administration, personnel, bookkeeping, service and maintenance, etc.) for every $1 million spent at the plant. Estimated in-house expenditures for the coming fiscal year (total expenditures less subcontracts and materials costs) are also available from the same sources at NASA which permits the calculation of total direct and indirect employment at the plant.

---

[1] See Appendix I for further discussion and derivation of demand estimate.

In addition, for each major award there are "manning curves" which indicate the number of man-years of direct labor required each year by occupational category (e.g., engineering manpower, production manpower, testing manpower, etc.) and, where the establishment is working on other projects at the same time, NASA can make available estimates of current and anticipated employment by occupational category prepared by the contractor for all ongoing projects at the plant.

Although these estimates of employment by category provide some information on the occupational mix required to perform the work, they may not indicate accurate levels of employment since, as was the case with the Corps of Engineers, annual appropriations on which these manning curves are based cannot be forecast with accuracy beyond the coming fiscal year. The appropriate manning curves, however, can be applied to the total direct in-house employment figure generated by the use of the historical manpower coefficient and the estimated expenditures for the coming fiscal year.

The resulting projections of employment at the plant by broad occupational group can be refined into more detailed occupational projections by the application of data from the firm's Affirmative Action Plan, since, where there are to be no major changes in the character of the work, the occupational distribution within the broad categories can be expected to remain relatively constant. In some cases the Affirmative Action Plan may not contain a complete occupational breakout. For example, it may only indicate the number of craftsmen, operatives and helpers. In such a case, company production managers may provide detailed occupational information within the categories. And, as a final resort, Census data for the industry by state may be used for further detail. This may be necessary where the projections indicate an increase in service or clerical workers but occupational details are lacking. Where this occurs, the Census data for the aerospace industry for the state can show that the bulk of the service workers in this industry and area are janitors, porters and guards, or that most of the clerical workers in the industry and area are secretaries and typists rather than office machine operators or clerks.

Finally, the projected increase in employment by occupation can be adjusted for turnover based on data from the Affirmative Action Plan. Adjustment for quits is not considered feasible since this fluctuates due to factors which may not be related to the work level at the establishment. Deaths, retirements, promotions, etc. may also be ignored where they account for few workers. However, if the firm has an active promotion or upgrading program, for instance, involving a large number of workers annually, the upgrading of these workers could create a substantial number of additional job opportunities at lower skill levels and this data should be used in preparing projections. In a period of rising employment at the establishment, this would be of considerable significance.

In the case of the Space Shuttle Main Engine award, the historical manpower data for the Rocketdyne plant indicated that in FY 1973 $27.2 million was spent at the plant on the SSME and direct employment amounted to 598 workers, resulting in a manpower coefficient of 22 man-years of employment for every $1 million of in-house expenditures. Although overhead employment generally amounts to 76% of direct employment at the plant, according to NASA program officials overhead employment on the SSME in 1973 was equal to direct due to the developmental character of the current phase of the SSME project. In FY 1973, therefore, estimated total employment at Rocketdyne on the SSME was equivalent to 1,196 man-years.

Rocketdyne reported that FY 1973 total employment at the plant was 3,144 man-years. The total number of workers employed on all other projects at the plant was calculated at 1,948 man-years by subtracting the 1,196 man-years for the SSME from the plant total. Since NASA supplied data on the number of direct employees on all other projects at the plant, it was possible to compute the percentage of employment on all other projects at the plant attributable to direct and to overhead employment.

An example of the application of these relationships to FY 1974 is contained in Table 7. Given the estimate of $43.5 million for SSME in-house expenditures by NASA in FY 1974, application of the SSME direct manpower coefficient indicated that SSME direct employment would amount to 906 man-years. (The coefficient was reduced to 21 man-years per $1 million of expenditures to take into account productivity increases and the lower labor intensity of the work as the project moved from the design phase towards production.)

Table 7

Derivation of the Manpower Coefficients for Rocketdyne in FY 1973 and Their Application in the FY 1974 Estimates

	Actual FY 1973	Estimated FY 1974
ALL PROJECTS		
Total Man-Years	3,144	3,512
SSME		
"In-House" Expenditures (in millions)	$ 27.2	$ 43.5
Direct Man-Years	598	906
Direct Manpower Coefficient (man-years/$1 million expended)	22	21
Overhead Man-Years as a Percent of Direct Man-Years (estimated by NASA)	100%	86%
Overhead Man-Years	598	779
Total SSME Man-Years	1,196	1,685
OTHER PROJECTS		
Total Man-Years (total all projects less total SSME)	1,948	1,827
Direct Man-Years (provided by NASA)	1,107	1,038
Overhead Man-Years (total other projects less direct other projects)	841	789
Overhead Man-Years as a Percent of Direct Man-Years	76%	76%

SSME overhead employment was calculated from the direct man-years using an 86% rate because, according to NASA, the overhead rate would also decline towards the rate for other projects at the plant as the SSME moved towards the production phase.

Direct man-years figures for all other projects at the plant were provided by NASA and overhead employment for these projects was calculated by using the 76% rate derived from the FY 1973 data. These procedures are described in greater detail in Appendix I.

NASA data on anticipated expenditures on the SSME, NASA-furnished company projections of direct employment on other projects at the plant, and the application of the coefficients derived above indicate that total man-years of employment at the plant is expected to rise to 3,512 in FY 1974 and to 3,832 in FY 1975. The SSME is expected to constitute an increasing proportion of total employment over this period. By FY 1977, employment on the SSME alone is expected to reach 2,760 man-years.

The development of occupational projections from these totals is more difficult than in the case of the Corps of Engineers award. However, occupational detail can be secured from numerous sources, including the Rocketdyne Affirmative Action Plan, the Rocketdyne production management staff, NASA program officials, California census data and BLS survey data. These occupational data were used in what may be termed an "iterative" process. Total employment was broken into broad occupational groups (e.g., professional, technical and kindred workers; craftsmen and operatives; etc.) based on the company's Affirmative Action Plan. Specially prepared company data was supplied for key occupations, such as tool and die makers and welders, in the craftsmen and operatives category. The remaining employment in the craftsmen and operatives group and in other groups was distributed by "fitting" occupational details obtained from 1970 California census data on occupations by three-digit industry to the control group totals. For example, in the office-clerical group, the ratio of office-clericals to total employment was put at 15.5 percent based on the AAP. California census data for SIC 372 put the ratio at 18 percent. Data for specific occupations within this group (i.e., secretaries, stenographers, typists, office machine operators, etc.) were estimated by applying the census distribution of occupations within the category to the office-clerical ratio obtained from the AAP. The occupational projections prepared for the Rocketdyne plant must undergo adjustment for such items as deaths, retirements, and terminations. Data for these changes are available from the AAP. In the case of Rocketdyne, historical information shows that over 2 percent of the work force at the plant die, retire or are discharged annually, an amount which is of sufficient magnitude to warrant making these adjustments. The results of these calculations are presented in Table 8.

When adjusted to show employment by six-month intervals, these projections by occupation for the Rocketdyne facility indicate a moderate level of new job openings in many occupations during 1974. As much of the design work is completed during this period, employment of engineers, scientists, etc. is likely to decline, resulting in some lay-offs. In production occupations, however, new hires are expected to rise as the firm begins an effort to produce prototypes of its designs for test purposes prior to going into full production. The projections indicate that the increases are likely to occur for sheet metal workers, assemblers, and checkers and examiners, all of which are suitable occupations for

Table 8

Employment and Job Openings, by Occupation, at Rockwell International Rocketdyne Division, December 1973-June 1975

Occupation	Employment			Estimated Job Openings(2)	
	Estimated Actual	Projected			
	12/73	12/74	6/75	1974	January-June 1975
Total	3,512	3,832	4,010	492	261
Professional, Technical and Kindred	1,440	1,380	1,350	[42]	[21]
Scientists and Engineers	822	786	768	[30]	[15]
Other Professional	379	364	356	[10]	[5]
Technical	172	165	162	[2]	[1]
Draftsmen	67	65	64	0	0
Managers and Sales	316	345	360	46	23
Craftsmen and Operatives	1,106	1,399	1,563	360	194
Tool Makers	135	89	71	[46]	[18]
Machinists	215	226	232	16	8
Welders	72	78	81	6	3
Sheet Metal Workers	106	129	141	23	12
Precision Assemblers	44	70	86	27	17
Other Assemblers	114	157	183	44	26
Foremen	84	130	158	49	30
Checkers and Examiners	68	105	128	39	24
Engine Mechanics and Repairmen	96	149	174	56	28
Electricians	20	28	33	8	5
Pattern and Model Workers	12	22	25	10	3
Other Production Workers(1)	140	216	251	82	38
Clerical	545	593	617	53	29
Secretaries, Stenos., and Typists	179	195	203	20	10
Clerks	158	172	179	15	8
Office Machine Operators	43	46	47	4	1
Other Clerical	165	180	188	19	10
Service Workers and Laborers	105	115	120	28	15

---

(1) Includes all craftsmen and operatives in occupations which account for less than .5 percent of total employment.

(2) Employment increase adjusted for deaths, retirements and discharges.

Note: Bracketed figures indicate the amount by which lay-offs exceed normal replacement needs.

training. Precision assemblers, engine mechanics and repairmen, and machinists are less likely candidates for training because of the high skill level involved; however, special recruitment efforts may be required to fill these jobs and if workers cannot be recruited it is probable that training to upgrade lower level workers into these jobs will be needed. Training could also be provided for the additional clericals and service workers needed, although the numbers required are modest.

The Rocketdyne projections indicated a moderate increase in employment over the next year or so which the firm felt could be managed for the time being through the recall of laid-off workers, recruitment from other divisions of Rockwell, etc. The Space Division, however, which is working on the $2.6 billion space shuttle orbiter, and the B-1 Division, which has a Department of Defense contract for the $2 billion B-1 bomber, are also located in the Los Angeles area and are expected to require much larger additions to staff that might require the support of government training, recruitment, or other manpower programs. Accordingly, the Space and B-1 Divisions were included in the NPA study. Due to the late involvement of the Space Division in this project, the estimates of employment by occupation prepared for the Space Division plant have relied primarily on NASA and industry data, with a minimum of company information.

Table 9 shows the projected manpower needs of the firm and the increases estimated for each occupation. These figures have been adjusted to reflect the additional workers needed due to deaths and retirements. The occupational detail is subject to revision, since the award is still

Table 9

Employment and Job Openings by Occupation at Rockwell International Space Division, December 1973-June 1975

Occupation	Employment: Estimated Actual 12/73	Employment: Projected 12/74	Employment: Projected 6/75	Estimated Job Openings(2) 1974	Estimated Job Openings(2) January-June 1975
Total	10,717	16,304	19,239	5,950	3,168
Professional, Technical and Kindred	4,747	6,701	7,750	2,047	1,107
Managerial and Sales	1,051	1,484	1,716	465	252
Craftsmen and Operatives	1,704	3,619	4,560	1,966	980
Tool Makers	82	184	234	105	52
Machinists (incl. mach. op.)	349	785	1,000	446	223
Welders	39	88	112	51	25
Sheet Metal Fabricators	43	96	123	55	28
Assemblers	261	586	745	333	165
Foremen	273	404	469	137	69
Checkers and Examiners	132	296	377	168	84
Engine Mechanics and Repairmen	189	425	541	241	121
Electricians	35	78	100	45	23
Pattern and Model Makers	27	61	77	35	17
All Others(1)	274	616	782	350	173
Clerical	2,958	4,109	4,752	1,327	752
Secretaries, Stenos., and Typists	980	1,361	1,574	439	249
Clerks	848	1,178	1,362	380	216
Office Machine Operators	232	323	374	105	60
Other Clerical	898	1,247	1,442	403	227
Service Workers and Laborers	257	391	461	145	77

---

(1) Includes all craftsmen and operatives in occupations which account for less than .5 percent of total employment.

(2) Employment growth plus deaths and retirements.

in the design phase, which may involve changes in concept and focus that can influence the character of the plant work force. Once the project approaches full production, however, estimates of the number of workers needed by occupation should be less subject to modification.

Although much of the new hiring required will be for professional and technical personnel, there will be opportunities for machine operators and assemblers, which are potential fields for manpower training. Most of the clerical openings also are suitable for training programs. In addition, the firm has an immediate need for special recruitment assistance for hiring minority workers in professional, technical and clerical occupations in order to fulfill its affirmative action program.

No projections were prepared for the B-1 Division since this would have involved a totally new effort in identifying data and data sources in the Department of Defense for which there was not sufficient time. The firm, however, reported that if the B-1 bomber program goes according to schedule, they will be hiring upwards of 14,000 workers over a one to two year period beginning in FY 1976. According to the firm the bulk of these openings would be suitable for training or other manpower program activities.

The Urban Mass Transportation Administration/Pullman-Standard Award.

In the case of the Corps of Engineers and NASA awards, almost all the data are available from government sources. This is not the case where Urban Mass Transportation Administration (UMTA) grants are concerned. Accurate projections for awards resulting from Urban Mass Transportation Act grants will require substantial cooperation from the contractor. UMTA does not investigate or project the contractor's manpower requirements, but merely acts as a conduit for Federal grants to local transit authorities. All UMTA receives once the contract is awarded is a monthly accounting statement from the local authority showing dispersal of funds.

While the local transit authority is similarly not concerned with manpower at the plant, it is concerned with receiving deliveries on time. Consequently, in the award studied by NPA, progress payments by the New York City Transit Authority (NYCTA) to Pullman are based on a scale which provides 20 percent payment when work is 25 percent complete on a particular car, 20 percent more for the next quarter of work, 20 percent more when the car is 75 percent finished, 30 percent payment upon delivery, and the final 10 percent upon acceptance. The contract also provides for delivery of the cars on specified dates. The Transit Authority has charted the anticipated progress payments over the life of the contract based on this information. This "payment schedule" is a suitable measure of work effort over time.

The appropriate manpower coefficients to apply to the dollar measure of work effort to obtain employment cannot, however, be derived from government sources or industry-wide data in the case of subway car projects. There are only about a half dozen firms producing subway cars, and the production techniques even among these six or so vary considerably. For example, the truck bodies for the cars account for 15-20 percent of the cost of a car, and the manpower requirements at the contractor's plant will vary considerably depending on whether or not he normally subcontracts this work to another firm. Census data, therefore, are not satisfactory for developing projections of occupational requirements.

Company data are therefore necessary for estimating occupational manpower needed per unit of output. While the firm may be reluctant to release certain types of proprietary information, our experience indicates that the firm will provide the minimum data required. In the case of the Pullman Company, for example, the company estimated that it would need a work force of 1,184 to produce at the rate of two completed cars per day. The company further revealed the occupational composition of these workers, for example, 95 punch operators, sheer operators and press operators; 19 hole and milling machine operators; 190 electrical workers; 247 fitters; etc. Pullman-Standard also provided data on turnover at the plant.

Knowing the number of workers required to produce two cars a day and the cost of the two cars, it is simple to calculate the number of man-days expended per dollar of expenditures at the two-car-a-day rate. This coefficient can easily be converted to the number of man-days required per $1 million of expenditures at the two-car-a-day rate for convenience. Since expenditure figures were on a monthly rather than a daily basis, the coefficient was converted into man-months of work by dividing by the average number of working days in a month (21), resulting in a manpower coefficient which represents the number of man-months of work per $1 million of expenditures at the two-car-a-day rate. Table 10 shows how these data were used to prepare the projections of peak employment at Pullman.

Table 10

Estimated Peak Employment at Pullman-Standard
Based on Company Production Data

	Company Production Data (Two-Car-A-Day Rate)	NPA Estimate (at peak production)
Number of Workers Needed	1,184	1,178
Dollar Cost of Production Per Day (in millions)	.556	-
Dollar Cost of Production Per Month (in millions)	-	11,615
Man-Days Per $1 Million of Expenditures	2,131	-
Man-Months Per $1 Million of Expenditures	101.38	101.38

For the subway car contract the manpower coefficient amounted to 101.38 man-months of work per $1 million of expenditures. (Had the scheduled production level differed substantially from two cars per day, a different manpower coefficient would have been required due to the effects of economies of scale. In the Pullman case, the company had also provided data on manpower requirements at the one-car-a-day level to provide for this contingency.) This coefficient was applied to the NYCTA work flow estimates as measured by projected expenditures, which averaged $11,615 million during the peak production period. The resulting projections of total employment - 1,178 workers - were distributed by occupation according to the company staffing pattern. These occupational projections were then adjusted for deaths, retirements and discharges.

The projections show that during the peak production period (July 1974 through September 1975), Pullman-Standard will need 1,260 production, maintenance and service workers to meet its production and delivery schedules. This includes some 80 workers required for other work at the plant, based on data also supplied by the company.

Pullman currently has about 300 production, maintenance and service workers employed at the plant. It expects to be able to recall only about 165 workers who are currently on lay-off status. The company will, therefore, need about 800 new workers by the last half of the 1974 calendar year, when it reaches full production on its current contracts.

Labor turnover will increase the number of "new hires" needed. During the first nine months of 1973 there was a 26 percent turnover in the plant work force, or about 3 percent a month. Company officials have indicated that with the huge increase in hiring of new workers without company loyalties, attachment to the work, etc., they expect the rate to rise. Since these rates might be reduced through careful recruitment and appropriate training programs, and since quits fluctuate greatly, a rate of 1 percent per month was used in developing the projections.

Table 11 shows the projected manpower needs of the firm and the increase in each occupational category. Key occupations for which manpower programs appear suitable include machine operators, fitters, welders, and electrical workers. Additional occupations may also be suitable for special attention, although they may involve smaller numbers of workers.

All of the production jobs at the Pullman Plant may be suitable for training. In many crafts, learners may be hired at the entry level, for which manpower programs could provide training. An opportunity also

Table 11

Employment and Job Openings, by Occupation,
at Pullman-Standard, December 1973-June 1975

	Employment			Estimated Job Openings(1)	
	Estimated Actual	Projected			
Occupation	Dec. 1973	Dec. 1974	June 1975	1974	January-June 1975
Total	307	1,260	1,260	897	76
Fabrication					
Machine Operators (punch, shear, press)	27	100	100	83	6
Production Machinery					
Machine Operators (hole and milling)	4	20	20	17	1
Fitting					
Fitters	42	257	257	190	17
Joining					
Joiners	17	132	132	105	8
Welding					
Welders	18	66	66	47	4
Sub-Assembly					
Assemblers	6	111	111	63	5
Pipe					
Pipe Fitters	12	40	40	31	3
Electrical					
Conduit Installers Wiremen Testers Cutters and Taggers	12	220	220	205	13
Paint					
Painters	12	77	77	52	5
Service, Labor and Maintenance	157	236	236	104	14

---

(1) Employment increase adjusted for deaths, retirements, discharges and recalls.

exists for upgrading training for current workers who wish to switch to higher skilled occupations or who require advanced skills because of the introduction of new production techniques. An example of upgrading training which may be required at the plant is in the welder occupation, where the firm intends to shift to the use of continuous welding equipment.

The monthly projections of expenditures indicate that major new hiring will not begin until towards mid-year. This provides sufficient time for local manpower programs to respond. Even after peak employment is reached there will be a need for a substantial number of additional workers due to the anticipated rate of turnover at the plant.

In all three of the Federal procurements studied in this phase of the project, the basic expenditure data for major awards become available in January of each year covering the coming July through June fiscal year. This allows estimates of the flow of work to be prepared up to eighteen months in advance. The manpower data provided by the contracting agencies are also available on the same advanced basis. This permits projections of employment opportunities to be prepared for all major Corps of Engineers awards by detailed occupation and for all major NASA awards by occupational group. Given the cooperation of the firm, detailed occupational projections can be prepared for all NASA and UMTA awards as well.

II. Assessment of the Projections

The value of these projections of job openings for manpower program planning will, of course, depend on their reliability. Although a true test cannot be completed until the projections can be compared with future actual employment levels, the methodology used produced results which conformed closely to available company estimates of overall employment or to known employment when tested for a prior period.

The Smithland locks project is the only one of the three awards studied for which the required data were available for a prior period. As a test of the methodology, employment projections were prepared using dollar expenditures by work task for the January-June 1973 period at Smithland and applying the manpower coefficients to these measures of work flow. The resulting "projections" of employment levels during this period were compared with actual employment during the same period at Smithland. This comparison appears in Table 12.

Table 12

Comparison of Actual and Predicted Values for Total Man-Hours(1) at Smithland, January-June 1973

Month	Actual	Predicted	Predicted/Actual
January	24,973	21,866	- 12%
February	31,597	22,061	- 30%
March	30,988	32,962	+ 6%
April	27,306	29,520	+ 8%
May	31,696	33,286	+ 5%
June	31,737	34,740	+ 9%
Six-Month Average	29,716	29,073	- 2.2%
Average Monthly Difference			11.7%

---

(1) Figures refer to average weekly man-hours per month. For detailed explanation, see Appendix I.

Except for the month of February, the estimates were within 12 percent of the actual. Since manpower programs would not be expected to respond to temporary peaks of this kind, a six-month average would be more likely a basis for identifying changes in employment levels which would warrant the involvement of manpower programs. For the six-month period, the estimated employment difference between the projected and the actual employment was less than 3 percent. It is important to note that the projections properly identified the peak and trough months.

Of even greater significance is the test of specific occupations at Smithland for March and May of 1973, the only months for which complete actual occupational detail was available at the time. Table 13 compares the actual and predicted values by occupation for these two months. Although the values are, of course, different in each occupation, the orders of magnitude for the various occupations are sufficiently close to form the basis for planning manpower training and recruitment programs.

Table 13

Comparison of Actual and Predicted Man-Hours(1),
by Occupation, for Two Months at Smithland

	March 1973		May 1973	
Occupation	Actual	Predicted	Actual	Predicted
Carpenters	8,405	9,951	9,463	10,531
Teamsters	1,688	1,520	1,637	1,609
Laborers	11,408	11,980	10,901	12,675
Operating Engineers	2,637	2,921	2,509	3,091
Mechanics	1,412	1,590	1,384	1,683
Oilers/Greasers	1,197	1,300	1,315	1,377
Total	30,988	32,962	31,696	33,286

---

(1) Figures refer to average weekly man-hours per months. For detailed explanation, see Appendix 1.

In neither the NASA nor the UMTA award has it been possible to conduct such a test, and the validation of the projections will have to wait for data on the actual employment which occurs in the periods for which the projections were made.

The projections prepared by NPA are the most detailed available from any source for these awards and are significantly different from the results which would have been obtained using macroeconomic data. Table 14 shows the figures which would have resulted from the use of industry data for the Rocketdyne-SSME award.

Table 14

Comparison of Projections of SSME and Total Rocketdyne Employment, Based on NASA Data and on Department of Commerce Data, FY 1974

Source of Data for SSME Projections	Projected Employment SSME(1)	Projected Employment(2) Other Projects	Projected Employment Total Rocketdyne
NASA DATA	1,685	1,827	3,512
DEPARTMENT OF COMMERCE DATA			
1967 Census of Manufacturers(3)			
Missile and Space Vehicle Engine R&D	2,050	1,827	3,877
Aircraft and Parts - Los Angeles/Long Beach SMSA	2,050	1,827	3,877
Shipments of Defense Oriented Industries, 1970(3)			
Purchases by NASA from Aircraft Engine and Parts Firms	2,335	1,827	4,162

---

(1) Employment figures obtained by applying the manpower coefficient calculated from each of the sources to FY 1974 expenditures.

(2) Employment estimate obtained from company data provided by NASA.

(3) Adjusted for productivity and price changes to 1974 levels.

The firm-specific data available from NASA, for example, produced projections of 3,512 man-years of employment at the Rocketdyne plant during FY 1974. The comparable figures which would have resulted from the use of Census of Manufacturers aggregate data or data from Shipments of Defense Oriented Industries would have been 3,877 and 4,162, respectively. Because NASA felt that the figures for total employment for all the other projects at Rocketdyne would not be subject to more than a small error, no effort was made to calculate these figures independently, and the differences in the totals are due entirely to differences in estimates of SSME manpower.

The occupational breakout would similarly have been different. Use of Census of Population data for California on employment by occupation for SIC 372 - Aircraft and Parts, in which Rocketdyne is classified, would have produced major differences in the occupational projections even if the same total employment base had been used (see Table 15).

Professional, managerial and sales workers would have been underestimated by more than 500 workers, while production workers would have been overestimated by almost 500 workers. Machinists would have been estimated 130 workers too high and assemblers by almost 100 too many. Tool makers and sheet metal workers would have been projected 53 and 62 too few, respectively.

The importance of these differences to manpower program planning are obvious. If aggregate data had been used for preparing the occupational projections, too much emphasis would have been placed on machinists, assemblers, foremen, etc., and too little on tool makers and sheet metal workers. The role of manpower training might also have been misinterpreted

Table 15

Comparison of NPA Occupational Projections with Projections Based on Aggregate Data, Rocketdyne Plant, FY 1974

Occupation	NPA Projections	Projections Using Census Data	Percent Difference
Total Employment	3,512	3,512	-
Scientists and Engineers	822	579	- 30
Other Professional	379	267	- 30
Technical	172	122	- 30
Draftsmen	67	47	- 30
Managers and Sales	316	224	- 29
Tool Makers	135	82	- 39
Machinists	215	345	+ 60
Welders	72	38	- 47
Sheet Metal Workers	106	44	- 58
Precision Assemblers Other Assemblers	158	252	+ 59
Foremen	84	162	+ 93
Checkers and Examiners	68	130	+ 91
Engine Mechanics and Repairmen	96	186	+ 94
Electricians	18	35	+ 94
Pattern and Model Makers	14	27	+ 93
Other Production Workers(1)	140	270	+ 93
Secretaries, Stenos, and Typists	179	205	+ 14
Clerks	158	180	+ 14
Office Machine Operators	43	49	+ 14
Other Clerical	165	190	+ 15
Service Workers and Laborers	105	78	- 26

---

(1) Includes all craftsmen and operatives in occupations which account for less than .5% of total employment.

Note: Figures may not add to total due to rounding.

since the projections would have identified the wrong jobs for training, as well as the total number of such jobs, due to an underestimate of the number of professionals needed during this phase of the work at the Rocketdyne plant.

Similar discrepancies in the occupational projections would have resulted in the other awards studied and are discussed at length in Appendix I.

To the extent that the NPA projections are reasonably accurate - and there is reason to believe that they are - they show that firm-specific data are a significant improvement over the use of aggregate data, and are a better basis for planning and establishing local manpower programs. Efforts to use the NPA projections for local manpower planning are described in the next chapter.

CHAPTER III

THE FIELD EXPERIENCE

NPA's efforts to encourage the use of the projections at the local level indicate that advance warning of job opportunities generated by major Federal procurements can act as a catalyst to improve local manpower program planning and operations. The projections can provide an opportunity for the local Employment Service to gain entry into major local firms and can help identify important training needs. The availability of projections prepared by outsiders can also stimulate the firm to improve its own manpower planning and prompt it to coordinate its manpower efforts with those of local manpower planning authorities. The Employment Service has a central part to play in these activities, both in improving its performance in its traditional role and in expanding its functions to include new services. It is unlikely that the projections would have the desired results without a field mechanism to provide technical assistance in interpreting and using them.

I. The Field Effort

In all the communities involved in this study, the magnitude and importance of the Federal procurement was known to local manpower program personnel soon after the award was made. In none of these cases, however, was any special effort made to assist the company to specify its needs and to coordinate the prospective increases in employment with local manpower activities. The firms themselves did not have much detailed manpower information on which to base such cooperation. Table 16 displays the manpower activities of the parties prior to the field effort.

In the Paducah area, a long history of the use of union hiring halls

Table 16

Company and Local Agency Manpower Activities Relevant to the Federal Award Prior to the Field Effort

Locality	Manpower Activities Prior to the Field Effort
CHICAGO	
Pullman-Standard Division	Specific manpower requirements not identified by the firm.
Local Agencies	Aware of the magnitude of the award, but no follow-up with the firm.
LOS ANGELES	
Rockwell International	
Rocketdyne Division	Detailed occupational projections not prepared by the firm.
Space Division	Detailed occupational projections not prepared by the firm.
B-1 Division	Detailed occupational projections not prepared by the firm.
Local Agencies	Aware of the awards, but no special programs designed for the firm.
PADUCAH AREA	
Dravo Joint Venture	No contact by the firm with local manpower agencies due to reliance on the unions for recruitment and referral.
Local Agencies	Aware of the award, but no contact initiated with the firm.
GROTON	
Electric Boat Division	Company expressed an interest in using government training funds, but had not prepared estimated of occupational training needs.
Local Agencies	In close working contact with the firm. Did not supply technical assistance in the preparation of occupational projections but did prepare request for funds to state manpower training authorities for overall training needs of the firm.

for recruitment and referral precluded any involvement of the local Employment Service in the work at Smithland, although the project generated a substantial increase in local construction employment. In Chicago, the local Employment Service labor market analysts reported the Pullman-Standard award and indicated that it would probably entail an increase of about 1,000 workers at the plant. The detailed occupational projections necessary for the development of manpower programs were not available, however, and the firm was not approached by local authorities until notified of the projections prepared in this study. At the time of the initial contacts by the research staff, the company itself had no projections of its manpower needs. According to Rocketdyne and Space Division officials, a similar series of events occurred in Los Angeles, except for a routine contact with the firm made by the local Employment Service. No cooperative programs were developed since the firm felt that staffing could be handled without the assistance of the agency. Under these conditions, detailed occupational projections were not prepared by the firm. And finally, in the case of the Electric Boat contract in Groton, Connecticut, the firm, working closely with the local Employment Service, prepared estimates of its total training needs as a basis for requesting state training funds. The company had not prepared estimates of training needs by occupation, however, and state manpower program authorities refused to finance the training at the time the request was originally made.

It was in this type of environment that NPA undertook to attempt to influence local manpower program planning and operations by focussing the attention of local program personnel on the potential need identified by the projections of job openings. The field effort involved the identification of the local decision-makers, the dissemination of the projections, and the provision of technical assistance in using the projections as a basis for selecting appropriate local manpower program activities. Preliminary meetings were held with the parties individually and a series of workshops were scheduled to stimulate cooperation and communications between manpower program authorities and the firms.

The field effort met with different responses, depending on conditions in the company and the labor market, and the historical relationship between the local manpower agencies and the firm. In all cases, however, changes took place in manpower planning either on the part of the firm, the local manpower agencies, or the unions. The manpower planning which took place subsequent to the field effort is displayed in Table 17 and a detailed discussion of the results of the field work is contained in the following section of this chapter.

II. The Results of the Field Effort

The experience in the project shows that an active program for disseminating the projections of job openings can result in the development of cooperative efforts between the employer and local manpower programs and the establishment of special program activities which probably would not have occurred otherwise. The degree to which these results can be achieved appears to be directly related to local labor market conditions.

Local manpower program planners will tend to limit their cooperation with the firm to activities they consider appropriate in light of the availability of workers. If sufficient workers with the required skills

Table 17

Company, Union, Local Agency Manpower Activities Involved in the Field Effort Through May 1974

Locality	Manpower Activities Involved in the Field Effort
CHICAGO	
Pullman-Standard Division	Company prepared staffing requirements per unit of production and cooperated in the preparation of projections of job openings. Company has listed 714 job openings with the Employment Service.
Local Agencies	Employment Service has undertaken special recruitment effort for firm. Company and manpower training authorities have reached tentative agreement to establish training programs for jobs not filled by recruitment.
LOS ANGELES	
Rockwell International	
Rocketdyne Division	Rocketdyne has prepared detailed projections for some occupations and has requested the assistance of local agencies to recruit and/or train minority workers.
Space Division	Space Division will not prepare detailed occupational projections until production phase is reached, but has requested the assistance of local agencies to recruit and/or train minority workers.
B-1 Division	B-1 Division will not prepare detailed occupational projections until production phase is reached, but has estimated new job opportunities for FY 1976 and FY 1977 at about 14,000 workers if work goes according to schedule and has requested the assistance of local agencies to recruit and/or train minority workers.
Local Agencies	Program Operators and the National Alliance of Businessmen are interested in establishing working relations with the firm. City and county manpower planning groups appear less concerned due to the pressures of reorganizing under CETA and other priorities.

Table 17 (Continued)

PADUCAH	
State Agencies	The State Manpower Planning Council and the State Department of Manpower Services have requested the union to submit a proposal for an upgrading training program for underemployed operating engineers in Kentucky.
The Unions	The national office and the Kentucky local union of the Operating Engineers are preparing a proposal to the State of Kentucky for a special upgrading training program to be financed out of MDTA funds.
Dravo-Groves-Newburgh	The firm continues to rely on the local unions for recruitment and referral.
Local Agencies	Illinois Employment Service and Oak Ridge Training Center both contacted the firm as a result of the follow-up in this study. Graduates of the Oak Ridge welding course may be referred to the Smithland site.
GROTON	
Electric Boat Division	Meeting held with the firm and Department of Labor staff as part of the follow-up. Estimates of training needs by occupation prepared by the firm after NPA projections were made available.
Local Agencies	The local Employment Service resubmitted the request for training funds to state authorities with occupational detail required and approximately 1,000 trainees have been enrolled in training programs to meet the manpower needs of the firm.

are unemployed in the area, the manpower planners can be expected to restrict their involvement to the development of special recruitment programs rather than training. Similarly, where the employer expects to encounter difficulties in finding workers with the necessary skills, they are more likely to evidence an interest in coordinating their efforts with those of the local manpower programs, even where they would not normally deal with the Employment Service. In Chicago, for example, the local manpower agencies have committed themselves to training workers for Pullman-Standard only in those occupations which are known to be in shortage. Pullman-Standard, on the other hand, which was reluctant to use the Employment Service but which anticipated difficulties in recruiting workers, has developed a working arrangement with the Employment Service as a result of the field efforts of this study.

The Pullman-Standard Award - Chicago. In Chicago, where the field effort is furthest advanced, the published labor market information revealed that the SMSA experienced an unemployment rate of about 4 percent in 1973. Employment growth in the manufacturing sector and in transportation equipment manufacturing increased during the year. Moreover, occupations widely used in the transportation equipment industry (and needed by Pullman-Standard), such as drill press operators and welders, were removed from the "surplus" category in mid-1973 and by the end of the year machinists, tool and die makers, electrical assemblers, and arc welders were in short supply.

The data clearly indicated that Pullman might be faced with a severe problem in recruiting the hundreds of new workers needed as it moved into full production on the subway car contract. Even under these conditions, however, the firm did not contact the local Employment Service because, according to company authorities, they did not feel that the Employment Service could serve their needs. Given the labor market conditions, however, a workshop attended by the firm and local authorities and using the data provided by this study has produced a significant degree of coordination between local manpower programs and the company.

At the Chicago workshop, each of the participants agreed to assemble additional data which was needed to work out program details. This has been followed up by a series of meetings between the company and manpower program staffs. A set of job descriptions has been prepared by the firm and checked out with the local Employment Service. From these job descriptions, all of the jobs at Pullman-Standard have been classified by the Dictionary of Occupational Titles code for the first time as an initial step in developing programs responsive to the needs of the firm. Over 700 job openings have been listed with the Employment Service and an active recruitment effort is now under way. About 500 of these jobs are reported to be at the entry level. In these cases, the Employment Service can make a major contribution in serving the needs of less skilled job seekers while at the same time helping the company avoid the problem of manpower bottlenecks which could result from a rapid increase in the work force.

In addition, alternative training program arrangements have been discussed. The Employment Service has estimated that a considerable number of the job openings are in shortage occupations which will require special training efforts. At the present time, there is an understanding that training programs will be developed for those jobs for which qualified workers cannot be recruited if the company and the union can agree on the procedure for selecting trainees, and discussions are currently under way to establish a training program for "car-builders."

This is a significant improvement over normal procedures. According to Pullman-Standard officials, the common practice of the firm was to attempt to recruit through other sources, such as gate applicants, newspaper ads, etc., when the job openings developed and to turn to the Employment Service only when all other efforts had failed. In this approach, information on the occupational needs of the firm would be provided to the Employment Service at too late a date for the government programs to react with any degree of success. Based on an early warning of occupational needs, however, the present recruitment and training activities are now taking place with sufficient lead time for successful efforts to be launched by the local manpower programs. The prospects, therefore, for having a significant impact on the employment requirements of the firm and on manpower program planning in the Chicago area appear to be very promising.

Rocketdyne SSME Award - Los Angeles. Although the unemployment rate in Los Angeles was much higher than in Chicago--over 6.5 percent in 1973--labor market conditions improved during the year. The area, in which the Rocketdyne plant is located, had experienced an increase in employment of 159,000 between January and December of 1973. Almost one third of the increase was in manufacturing.

Under these labor market conditions our initial contacts with Rocketdyne were successful. The firm provided data on manufacturing employment specially prepared for this study and indicated a willingness to cooperate with the local manpower programs. Subsequently, however, NASA's budget plans for the SSME were revised downwards and the stretch-out of the project resulted in an anticipated increase in employment of about half of the level originally expected. At this point Rocketdyne officials became reluctant to involve themselves with local programs since they felt that they had a sufficient supply of workers from their own recall lists.

Under these conditions it was decided to maintain contact with the firm in order to spot developing manpower bottlenecks, since with the passage of time the firm was likely to exhaust its roster of laid-off workers and, if the economy of the West Coast continued to expand, the firm might encounter difficulties in recruiting the necessary workers and need the assistance of local manpower programs. Manpower shortages could even occur by FY 1975 if SSME expenditures are speeded up in order to meet the original delivery schedule.

In the course of maintaining contact with the Rocketdyne Division, it was learned that staffing problems might also arise at its sister firms--the Space Division, which is working on a $2.6 billion NASA award, and the B-1 Division, which is working on a $2 billion Department of Defense contract. Through the Rocketdyne Division, contact was established with officials at the corporate headquarters in Pittsburgh and the parent company, Rockwell International, involved the Rocketdyne, the Space, and the B-1 Divisions, all of which are located in Los Angeles, in a workshop with local manpower program authorities.

Representatives of the three divisions of Rockwell International in the Los Angeles area, the city and county manpower planning councils, manpower program operators, the local office of the National Alliance of Businessmen, and the Department of Labor Regional Office attended the conference conducted by NPA in Los Angeles.

Although none of the three divisions were as yet in full production and had been able to recruit workers from their recall lists, all of them were interested in working with local manpower agencies. At the present time all three divisions of Rockwell in the Los Angeles area have a need for special recruitment services to help them increase the number of minority workers in professional, technical and clerical occupations. They also anticipate difficulty over the long run in hiring the necessary workers when they are at full production and peak employment is reached in the next few years. The local manpower program operators were prepared to work with the firm due to the good jobs and high pay offered by these employers. However, the local manpower planners appeared reluctant to provide special services to the firm. This seemed to be, in part, due to the fact that the funds available would meet such a small part of the need in the local area that the manpower program planners felt that special efforts directed towards selected firms were not warranted. Moreover, under CETA six separate prime sponsors will be designated for the area from which the firm normally recruits its workers and the manpower planners appeared to feel that the firms might best coordinate their manpower activities with the prime sponsor with jurisdiction over the area in which the plants were situated. It is not likely that the desired cooperation will be obtained unless the Department of Labor continues to work closely with the local agencies in an effort to influence their use of manpower program resources.

Smithland Civil Works Project - Paducah. The experience in the Smithland project in the Paducah area indicates that a different approach is required for the heavy construction industry. In heavy construction, the unions are likely to make more use of an early warning system than the employers since the unions bear most of the responsibility for recruiting and supplying workers.

In the case of the Smithland award, once the projections had been prepared, the contractor was contacted in order to develop appropriate manpower programs for the Smithland site. Except for some specialized workers, however, the firm relies almost entirely on the local unions for recruitment and referral.[1]

As an alternative to working through the firm, efforts were begun to involve the unions in the project. Discussion with persons familiar with the construction labor unions revealed that most large contractors in the heavy construction field (if they are unionized) have contracts with the national office of the various crafts rather than with the local. Moreover, some unions maintain their own training facilities. For example, the International Union of Operating Engineers sponsors a number of Job Corps Centers located throughout the country. The two crafts (operating engineers and construction laborers) for which the projections indicated the bulk of the increase in employment at Smithland were therefore contacted.

The national office of the construction laborers felt that it was not profitable to coordinate their programs in the case of Smithland because of the small number of workers involved and the fact that laborers in the area were not highly mobile. They would, however, cooperate in other cases where large shortages could be anticipated. The national office of the Operating Engineers Union, on the other hand, was willing to work with state and local manpower program authorities for recruitment, referral and training, since the type of information provided by an early warning system would permit the union to expand training opportunities or to use the project site for placement of their graduates.

---

[1] The firm did evince an interest in a special program for "certified" welders. Contact was initiated between the contractor and the Oak Ridge Training Center and the Center has agreed to refer to Smithland any of their graduate certified welders who remain unemployed.

A meeting took place in January which was attended by the Director of Training of the International Union of Operating Engineers, the union locals in the region, and NPA. The local unions did not see a need for recruitment or entry level training programs organized in conjunction with state and local manpower program authorities, but expressed considerable interest in arranging upgrading training activities.

The operating engineers locals in the Smithland area were concerned about numbers of union members with limited skills who cannot find steady employment and experience lengthy periods of unemployment when the equipment they are capable of operating is not needed. The unions are anxious to broaden and upgrade the skills of these workers in order to improve their employability. A successful upgrading program may, in time, also increase the need for workers on smaller or less complex pieces of equipment and create entry level training needs. The local unions, therefore, agreed to meet with state manpower planners to discuss upgrading training programs for workers, not only at the Smithland site but for all projects in their jurisdiction.

A workshop, such as was held in Chicago, was conducted in Louisville, Kentucky. Members of the operating engineers' national office and the local with jurisdiction in Kentucky, as well as the Executive Secretary of the State Manpower Council and the State Commissioner of Manpower Services, attended the conference conducted by NPA. A presentation was made of the data on underemployment among union members with limited skills and a discussion of the need for upgrading training. The union indicated that it is required to recruit both union and non-union members for employment and training and would be prepared to follow these practices in selecting trainees for upgrading programs as well.

The Commissioner of Manpower Services approved of the idea of an upgrading training program for operating engineers sponsored and conducted by the union, especially if it could be focussed on the eastern Kentucky area where so many workers were underemployed and where incomes were at or below the poverty level. A special proposal for such a program, however, will have to be submitted to the State Manpower Council under existing procedures. NPA has assisted the union in preparing the proposal which should be submitted shortly. There is, therefore, strong likelihood that a special upgrading training program to improve the employability and income of operating engineers with limited skills will be established in Kentucky.

In the unionized segment of the heavy construction industry, it appears that the most promising approach to developing special manpower program activities is through direct contact with the national and local offices of the unions involved rather than with the employer. The approach of working through the unions also appears to be particularly well suited to the problem of increasing the representation of minority workers in the construction trades in those localities which are too small to have local Affirmative Action Plans for the construction industry. The national offices of the construction unions have, by and large, made an effort to accommodate to Federal requirements relating to equal employment opportunity. Advance notice of an increase in the need for training and recruiting workers for the construction industry could permit the unions to plan their training, placement and recruitment efforts with greater effect.

III. Conclusions

Based on the field experience it is fair to say that under the proper conditions local employers, unions and manpower planners will respond to the type of projections of job openings prepared in this study and will cooperate to identify and establish appropriate manpower program activities. This can result in better manpower planning by both employers and local authorities and the improvement in the performance of local training and placement programs.

The local Employment Service has a major role to play in this process, since it is the best informed agency regarding local labor market conditions, which, to a large extent, determine the appropriateness of alternative manpower program activities. Where experienced workers with the necessary skills are available, a special recruitment effort would be called for; where they are not, a training program would be in order. In Chicago, for instance, welders are being recruited for Pullman-Standard from the experienced labor force but a training program is being planned for car-builders, which is an occupation in short supply. Similarly, the existence of experienced workers who are unemployed or underemployed due to limited skills would warrant an upgrading training program, as is the case for operating engineers in Kentucky.

The Employment Service is also a prime point of contact between local manpower program planners and the firm, since its normal functions involve continuous interaction with employers, and the staff are knowledgeable about many of the larger local firms. Moreover, the experience in this study indicates that where the employer anticipates a tight labor market and difficulty in recruiting the necessary manpower, advance notice of job openings resulting from a major Federal procurement award can influence the employers to cooperate with public manpower programs and to gain the Employment Service entry into large local firms which they may not have serviced before. This appears to be the case even with employers who are reluctant to deal with the Employment Service, as was the case with Pullman-Standard in Chicago.

The field work undertaken in this study also emphasizes the need for a follow-up effort in which the local manpower program planners and operators must play a large role. The potential improvement in the functioning of local manpower programs possible through an early warning system, however, is not likely to be achieved without some effort on the part of the Department of Labor, since such improvements would require that local authorities expand their activities beyond those routines which have become traditional and accepted practice. The Department of Labor will be required to contact the parties, arrange for meetings and conferences to work out the details of manpower program-employer-union cooperation, provide technical assistance in developing and interpreting the information on job openings, etc.

These activities on the part of the Department of Labor can also stimulate the companies and/or the unions to initiate or improve their own manpower planning. As a result of the field activities of this study, for example, Pullman-Standard developed staffing requirements per unit of production and Rocketdyne expanded its manpower forecasting efforts to include selected occupations in its manufacturing department.

The three conferences held in conjunction with this study also indicate that, at least initially, the necessary field work and technical assistance must be provided by the national office of the Department of

Labor. Only limited support can be expected from the regional offices during the establishment of the system. In the case of the Chicago conference two regional office representatives were present, and one regional office staff member attended the Los Angeles conference. Each of these Department of Labor representatives supported the efforts of the project but could not contribute much to the discussion because their knowledge of the data sources and the projections was limited. At the Kentucky conference no regional office personnel attended due to the pressures of other business. Under these conditions the major change agent role would have to be assumed by the staff of the Early Warning Unit.

The movement to decentralization and manpower revenue sharing under the Comprehensive Employment and Training Act will also require the involvement of Department of Labor national office staff as catalysts in stimulating the use of the projections in local manpower program planning. Even in Chicago, where both the company and the local manpower planning council were convinced of the benefits of working together, it was necessary to provide the stimulus through a series of meetings organized by an outside group (NPA). In Kentucky, although the union and state manpower program authorities were anxious to cooperate, a special proposal to the State Manpower Planning Council was required. Much of the data and analysis for such a proposal could best be prepared by the Early Warning System unit. The Los Angeles experience indicates even more strongly the need for the involvement of the Early Warning System unit in the field effort. While manpower program operators and the company were ready to coordinate their activities, the representatives of the manpower program planners seemed less committed. To gain the benefits of an early warning system under such conditions will require substantial field activities on the part of the Early Warning System staff.

Due to the time and personnel required for these field activities, the Early Warning unit would probably have to restrict its review of Federal procurements to a relatively small number of the largest awards during the early stages of the establishment of the system. A good part of the field work, however, may be assumed by the Department of Labor Regional Offices as they become more familiar with the work of the "system" and gain experience in its use at the local level. As the Regional Office became more actively involved in the field, the Early Warning Unit could substantially increase the number of Federal contract awards reviewed annually.

CHAPTER IV

THE MODEL EARLY WARNING SYSTEM

The findings in this study make it evident that an operating early warning system can serve a useful function as a regular, ongoing activity of the Department of Labor. Such a system would identify major Federal procurement awards likely to create sizeable numbers of job openings in the local community, collect the data relating to the award from a variety of sources, and prepare projections of the job opportunities resulting from the procurement. The system would also conduct a field effort which would include disseminating the projections and providing technical assistance to the users at the state or local level in order to develop special training, recruitment, or other manpower program activities. A functioning early warning system could yield significant benefits in terms of improved local manpower program planning and operations, more assured and better paying employment for trainees, and fewer staffing problems for large local employers.

Chart 1 displays the relationship between the Early Warning System and the manpower program decision-makers and other users of the projections, and identifies the specific tasks that an early warning system unit should undertake in order to influence the operations of manpower programs at the local level.

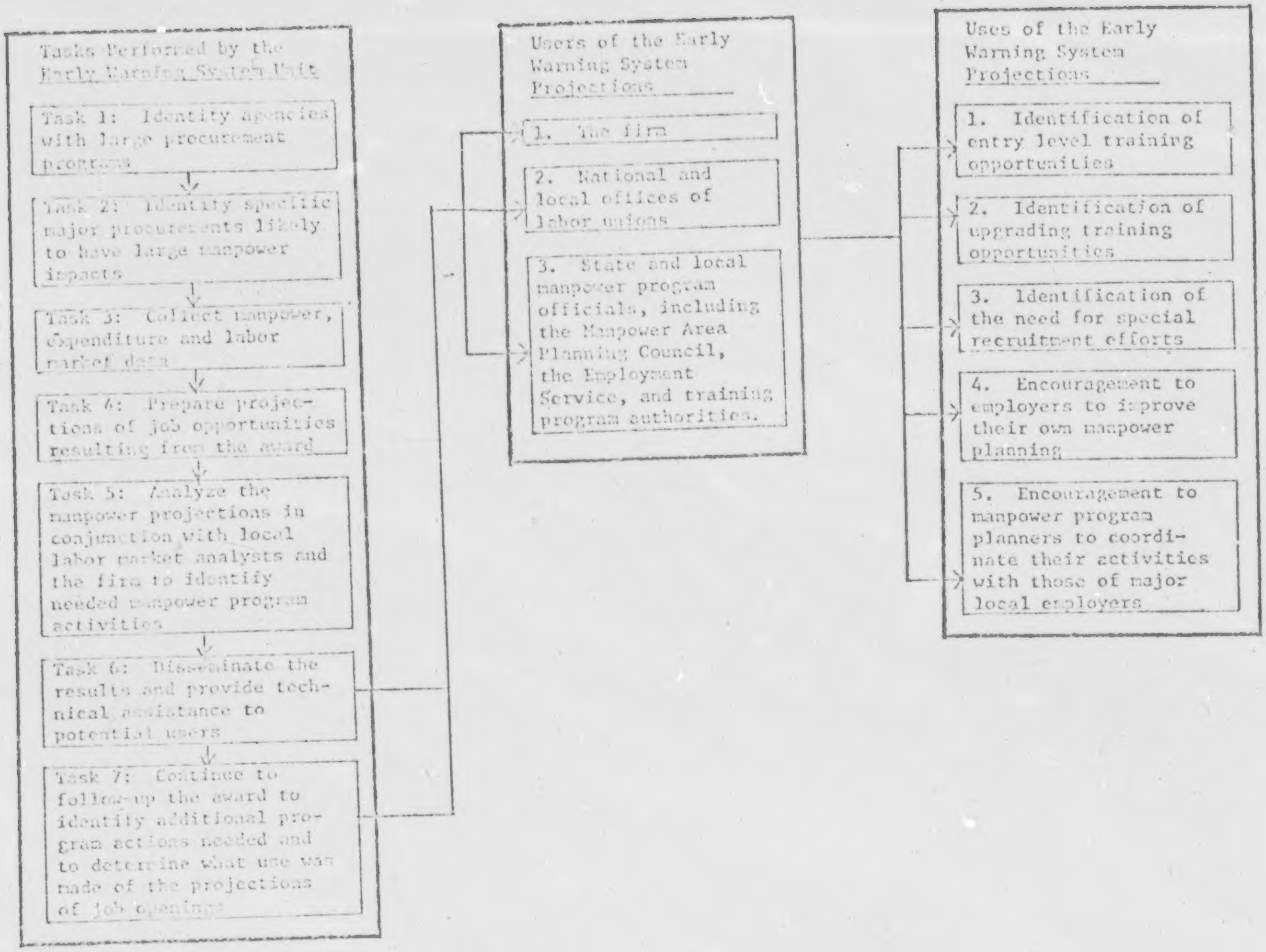
I. The Functions of an Early Warning System Unit

The tasks of an early warning system unit outlined in Chart 1 fall into three categories: identifying and selecting contracts to be studied; collecting the required data, preparing the projections of job opportunities, and making an initial determination of the need for local training,

BEST COPY AVAILABLE

Chart 1

The Role of the Early Warning System


Tasks Performed by the Early Warning System Unit
Task 1: Identity agencies with large procurement programs
Task 2: Identify specific major procurements likely to have large manpower impacts
Task 3: Collect manpower, expenditure and labor market data
Task 4: Prepare projections of job opportunities resulting from the award
Task 5: Analyze the manpower projections in conjunction with local labor market analysts and the firm to identify needed manpower program activities
Task 6: Disseminate the results and provide technical assistance to potential users
Task 7: Continue to follow-up the award to identify additional program actions needed and to determine what use was made of the projections of job openings
Users of the Early Warning System Projections
1. The firm
2. National and local offices of labor unions
3. State and local manpower program officials, including the Manpower Area Planning Council, the Employment Service, and training program authorities.
Uses of the Early Warning System Projections
1. Identification of entry level training opportunities
2. Identification of upgrading training opportunities
3. Identification of the need for special recruitment efforts
4. Encouragement to employers to improve their own manpower planning
5. Encouragement to manpower program planners to coordinate their activities with those of major local employers

recruitment, or other manpower program activities; and a field effort designed to disseminate the projections to the users, provide technical assistance in their use in manpower program planning, and assist in assessing the results of the Early Warning System and in identifying ways for improving the services provided.

Selecting the Contracts for Study. The initial tasks--identifying agencies with major procurement programs and selecting specific awards for study--require a review of the Federal budget and contact with the office of the chief procurement officer in each agency with a sizeable procurement budget. The results of the review conducted in this study are described in detail in Appendix II. The procurement officials in each agency can provide data on all major awards of the agency and can obtain information from the program staff responsible for each award on the likely manpower impact of the award and any detailed manpower data collected by the agency. From this information, almost all of it available from within the Federal establishment, it is possible to select specific contracts which promise to have a measurable impact on local labor markets.

In selecting the specific contracts to be studied, the Early Warning System unit would apply a series of criteria to identify those awards most likely to result in the need for special manpower program activities. These criteria include: 1) the number of job opportunities likely to occur over the coming fiscal year; 2) the wage rates the jobs will pay; 3) the occupations in which the job openings will occur; and 4) prospects for the job leading to reasonably continuous employment.

Contracts to firms which will create job openings that pay less than the average for the area because the firm is, for example, in a low paying industry, are not likely to be of interest to workers, trainees, or the local manpower program operators and would not be suitable candidates for an Early Warning System. Similarly, where a surplus of workers is available for the job openings there would be little need for special efforts for recruitment or training. Awards which will generate employment only for professional or administrative workers would also be of little interest to the Early Warning System since such workers are normally recruited or trained through other channels.

By and large, contracts which will provide only short-term employment, such as Federal procurements which are expected to be completed within a six-month period, should not be considered. In some industries, however, like heavy construction, employment normally fluctuates. However, high wage rates and opportunities for other employment elsewhere, compensate for the lack of job stability. These contracts, if they meet the other criteria, would be suitable candidates for an early warning system.

Another useful criterion to employ is that only procurements which result in an annual increase of $5 million or more of "value added" at the individual establishment over the prior year's level should be reviewed. Increases of less than $5 million in value added are likely to generate too few job opportunities, generally less than 250, to be worthwhile subjects for an early warning system.

For example, some large awards will be spread over so many employers, or plants, that the impact of any single community would be too small to require the special attention of the local manpower program authorities. In checking on the procurements of the Atomic Energy Commission, it was discovered that, although each of their current awards for nuclear power plants was in excess of $100 million, typically less than $5 million of the total award would represent production and employment at any one plant. The manpower impact of the award, therefore, was not likely to be significant in any single community.

In addition, a number of major awards which involve substantial expenditures for a single plant may be found which do not have any significant implications for employment and, therefore, for manpower programs. This will occur where there will be no change in manpower requirements at the plant because the value of the current contract merely offsets declines in the value of other awards at the plant. The number of workers required at the facility, therefore, is likely to remain the same. In reviewing Department of Defense procurements during the initial phase of this project, for instance, an aircraft manufacturer was identified who had received in excess of $400 million in awards from the Air Force but whose work force was expected to decline by over a thousand workers because the total business of the firm had declined from the level of the previous year. This information on potential future mass lay-offs, however, should be communicated to the local Employment Service. In the case cited above, the local Employment Service, although it knew that business at the firm had declined, was not aware of the magnitude of the lay-offs which were likely to occur until contacted by the project staff.

The information required for selecting awards is normally available from the contracting agency and published labor market data. In the four agencies studied in the project, only the Urban Mass Transportation Administration was unable to provide any of the necessary information and, even in that case, some of the data could be obtained from the New York City Transit Authority.

Preparing the Projections. Once having selected the contracts to be studied, the Early Warning System unit must collect the required detailed manpower data, prepare the projections, and determine if the job openings by occupation indicate a need for special training, recruitment or other manpower programs in the local area.

Where projections of employment at the establishment have been prepared by or for the contracting agency they can be collected from the program office responsible for monitoring the contract (see Appendix III). In the Rocketdyne case, for instance, the NASA program staff were able to provide not only their own projections of employment by department at the factory but also those prepared by the firm.

Additional information, such as staffing patterns for the firm, turnover by occupation, workers with recall rights by occupation, etc., can best be obtained from the firm directly, and the Early Warning System unit should contact the firm early in its examination of the award. From the experience with the four awards studied there is no advantage to deferring these contacts until the Early Warning System has prepared its own preliminary projections.

Where the firm will not or cannot supply the required data, use can be made of the firm's Affirmative Action Plan and industry information. This requires that the Early Warning System unit establish a close working relationship with the Office of Federal Contract Compliance, the Bureau of Labor Statistics, the Department of Commerce, and private trade associations.

Once the appropriate employment levels have been determined and job opportunities projected, they should be analyzed by the Early Warning System staff in light of such things as local occupational shortages, plant turnover, and numbers of workers with recall rights in order to identify "potential" manpower program action. The Early Warning System staff will have to rely initially on published labor market data which are available from all larger communities in the country. However, final judgments on the suitability of particular manpower programs must rely heavily on the local staffs. The local labor market analysts will have more recent and more detailed labor market information than is contained in the published reports and any final conclusions as to the suitability of a special manpower program activity must take into account the priorities of the local manpower programs themselves.

Where the published labor market data indicate that a special manpower program activity might be required to satisfy the job needs projected for the firm, the Early Warning System unit would be required to institute a series of field activities which include the dissemination of the projections, provision of technical assistance to the local manpower program authorities and a workshop designed to bring together the interested parties and to generate the necessary special manpower program activities.

The Field Effort. The key figures in developing special manpower training or recruitment programs at the local level are: the officials of the state and local Manpower Area Planning Council (MAPC) or similar group; the local Employment Service and manpower training personnel; company officials such as the directors of industrial relations or personnel departments; and, in some cases, the unions.

The field experience indicates that a preliminary meeting with these parties individually prior to bringing them together in a workshop increases the likelihood that the effort will be successful. These preliminary contacts can provide an opportunity to describe the services available from the Early Warning System to the firm or the manpower program planners. A description of these services and a discussion of the manpower and expenditure data already collected can provide the leverage needed for gaining the necessary cooperation of the parties. Preliminary contacts were also instrumental in stimulating the companies to develop their own manpower data.

In Chicago, for instance, the Pullman-Standard staff prepared the basic data necessary for the preparation of the projections after such a session, although they had originally expressed reservations about cooperating in the project and had stated that they were unable to provide any manpower information at all. In the case of Rocketdyne, a request for more detailed data resulted in a special company effort which provided the information, and, at the Electric Boat Division, detailed projections were prepared only after the firm was provided with a set of the NPA projections and a description of the methodology used.

The workshop itself should bring together the firm (or in the case of the construction industry, the unions), local and/or state manpower planners, representatives of the labor market analysis and manpower training offices of the Employment Service, and the staff which prepared the projections. In Chicago, it also proved useful to have staff members of the Department of Labor Regional Offices to provide support for the objectives of the project.

The experience in the field also shows that even where the firm is not interested in a workshop, contact should be maintained. In the Rocketdyne case, the firm was disinterested because of an assured supply of the necessary workers from its recall lists. However, continued contact resulted in the identification of a potential manpower shortage at the

Space and B-1 Divisions and a willingness on the part of the firm to arrange a workshop session with local manpower program authorities, as described in Chapter III.

The final activity the Early Warning System unit must undertake is a follow-up effort to provide continuing support to the local parties. Reviewing the results in the locality will enable the unit to provide additional data if needed and to suggest ways of coordinating the manpower needs of the firm with the program activities of local manpower planners where this has not been already accomplished. For example, in the Electric Boat award, one of the reasons given by state authorities for their initial reluctance to finance any sizeable training requirements of the firm was that the amount of funds required would "short-change" other labor market areas in the state. In the report on that contract, NPA suggested that training programs could be established in other, close-by communities which would prepare residents of those areas for jobs at Electric Boat. A recent check with state manpower planners has revealed that this alternative has been implemented and that training programs for Electric Boat are in operation in two near-by labor market areas.

The follow-up will also help the Early Warning System unit in assessing the value of the services it has provided and in devising ways for improving or expanding these services, where needed. The unit could identify the occupational detail likely to be most useful to local manpower agencies, the labor market conditions most likely to involve training programs, the most appropriate type of training, and similar considerations. In Kentucky, for instance, the follow-up identified the need for upgrading rather than entry-level training, the data necessary to substantiate this need, and permitted the project staff to participate in the preparation of the special proposal for submission to the State Manpower Council.

The activities described above are best carried out by a unit located in Washington, D.C., since most of the information and the procurement offices of the contracting agencies are centrally located there. The Department of Labor is the most reasonable base for such an operation, since the activities of an early warning system require extensive involvement with manpower data and dealings with local manpower program staffs whose backgrounds, experience and functions are most closely reflected in the Department of Labor.

Regardless of its geographic or organizational location, an early warning system unit would require a staff of manpower economists with a background in manpower projection techniques and data sources, along with manpower program specialists knowledgeable in the procedures, policies and practices of the various Federally supported manpower training programs and the Employment Service as well as experience in labor market analysis. A critical skill needed for the operation of an early warning system must be the ability to work with personnel of dissimilar organizations, that is, the companies, the local program staffs, and the engineering-oriented contracting agency staffs.

II. The Functions of the MAPC and Other Users of the Projections

The Role of the Manpower Area Planning Council. Under existing manpower revenue sharing policies, Federal manpower funds are allocated on a formula basis to the chief executive officer of cities and counties which meet minimum population criteria, with the remainder of the state allocation going to the Governor. The regulations delegate broad discretion in the use of these funds to the Governor, Mayor or County Executive and call for the establishment of state and local manpower planning groups which are responsible to the appropriate chief executive officer.

The follow-up effort in this project indicates that the state and local MAPC's or similar planning groups can be prime users of projections of job opportunities, and it is through them that the Department of Labor can influence local manpower program decisions. Since the local manpower programs are represented on the planning committees, these committees can be instrumental in developing the cooperation of local program personnel and in insuring their participation in the Early Warning System. In Chicago, for example, the local MAPC sponsored the workshop, provided the facilities for the meeting, and secured the attendance of Employment Service personnel.

The Role of the Other Participants. A critical party to the functioning of an early warning system is the local Employment Service. The initial determination of training program offerings, development of special recruitment efforts, and the primary contact with the firm are all responsibilities of the local Employment Service staff.

In coordinating manpower training and recruitment programs with the manpower needs of the employer, the role of the Employment Service labor market analysts is to update the published data which identify specific conditions in the local labor market (such as a shortage of workers with heavy metal-working experience) which indicate a need for special manpower program activities. Employment Service personnel must also provide many of the special services required. For example, the Employment Service is the sole local agency that can prepare and analyze the job descriptions according to the designations in the Dictionary of Occupational Titles code so that they can be used by Employment Service placement officers. Moreover, it is the Employment Service manpower training staff that must work with the company to identify alternative training arrangements, such as a mixture of on-the-job training and institutional training, use of the company premises for training, and use of company supervisors as instructors. The role of the Employment Service is illustrated by the experience with the Pullman-Standard contract in Chicago. The firm originally had reservations about relying on the Employment Service, but, after the workshop, coordinated its manpower planning closely with that of the local Employment Service with the results that have been described in the preceeding chapter of this report. This experience indicates that even where final program arrangements are not agreed to initially, the stage will have been set for further contact between the parties that can lead to the establishment of special manpower training or recruitment programs.

Among the other users of the projections of job opportunities, the firm is, of course, critical to the success of the Early Warning System. But, aside from the need for the firm's cooperation in planning recruitment and training programs, the employer, as in the case of Pullman-Standard, is also a potential supplier of manpower data used in preparing the projections of job openings. Moreover, the firm can play an important role in reviewing the projections for validity. In the Rocketdyne award, the firm was able to inform the project staff of a change in budget appropriations which reduced the projected increase in employment by half. Rocketdyne had been given advance notice of this change by NASA but the cut-back had not yet been incorporated into the expenditure figures provided to the staff of this study.

In addition to the local program authorities and the firm, the local unions will in many instances also be involved in the Early Warning System. The field experience in this study suggests that the involvement of the unions will vary by industry and by practices of the firm. It appears that in the manufacturing sector the involvement of the unions will depend on the collective bargaining arrangements of the employer. As in the case of Pullman-Standard, the development of special manpower programs raises issues related to recruitment, promotions, etc., which are covered by the collective bargaining agreement and which the firm would prefer to negotiate privately with the union.

In the construction industry, on the other hand, where the firms that are unionized rely on the union to supply workers, the firms are not likely to express strong interest in an active leadership role in participating in manpower programs. As in the case of Smithland, however, the unions may find it in their interest to coordinate their activities with those of state and local manpower program officials. Although the firm should be contacted and advised of the Early Warning System findings even in the construction industry, the focal point of any cooperative effort is likely to be the national and local construction unions.

The experience in this study shows that the parties will respond if presented with projections of manpower needs and sufficient lead-time to plan and budget special program activities. In both Chicago and Groton, for example, where it appeared that the necessary workers could not be supplied through normal channels, special manpower programs were devised.

III. The Role of the Department of Labor

Gaining the benefits of an early warning system would require the establishment of a unit to perform these activities as a regular function of the Federal government. There is little doubt that a good deal of the required manpower information is available to the firm in much more detail than it would be to the government. This includes such data as workers with recall rights by occupation, turnover by occupation at the establishment, etc. However, it appears from the experience with the awards studied that many firms do not engage in serious and timely manpower planning, and others regard the manpower data they do generate as proprietary information. At least some government contractors are not at present capable of preparing reliable projections, a situation probably related to the fact that the preparation of occupational projections is not required by the Federal contracting agencies.

Barring a major shift in Federal procurement policies or practices, therefore, projections of manpower requirements related to major government contractors will have to be prepared in large part by the Early Warning System itself. The Department of Labor, should it assume responsibility for the operation of an early warning system, should recognize that in addition to preparing projections of job openings it would also be called upon to assume the role of change agent in stimulating state and local manpower program authorities, major employers, unions, etc. to use this information in planning and establishing training, recruitment, and other manpower programs. Initially, the burden of this catalyst role, as stated in Chapter III, would fall largely on the shoulders of the Early Warning System unit, although, in time, a major portion of these field activities might be transferred to the Department of Labor Regional Offices.

The experience with the awards studied in this project has also provided some insights into ways that the Department of Labor could improve the operations of the Early Warning System. The Department of Labor could request contracting agencies to require that staffing plans be submitted as part of all large bids (and anually thereafter for those contracts which depend on annual appropriations). If this procedure were agreed upon and implemented, it would significantly reduce the work load for the Early Warning System by providing much of the raw data needed for the preparation of projections. Although such a procedure would require the cooperation of other government agencies, it would assist the contracting agency in assessing the ability of the bidder to perform satisfactorily and should not be viewed as an unreasonable burden on the firm.

Another possibility, which is more within the control of the Department of Labor, and, therefore, should be simpler to implement, involves the Affirmative Action Plan program. At present, this program is administered by various government agencies under authority delegated by the Department of Labor. In many cases the Affirmative Action Plan contains too little occupational information and may not be available in a timely fashion. For instance, the Rocketdyne Affirmative Action Plan did not contain detailed occupational information, although it would have been simple for the firm to provide it. In the case of the Pullman-Standard Affirmative Action Plan, it took months to obtain a copy of their plan through the Postal Service, which is the compliance agency. An effort on the part of the Department of Labor to require more detailed information on occupations, to insure up-to-date Affirmative Action Plans, and to make them available quickly and easily, would provide an important source of historical manpower data on selected firms and facilitate the functioning of an early warning system.

An added tool available to the Department of Labor for improving the performance of an early warning system involves the financing of manpower programs. In some cases, such as in the Electric Boat award, the manpower planners may be reluctant to act on the projections prepared by the Early Warning System. This may result from a basic distrust of the estimates, or from the fact that the program needs identified by the projections conflict with state or local priorities in allocating funds. In some instances, the Department of Labor could offer to supplement local funds as a means of overcoming any resistance on the part of the Manpower Area Planning Council to using the projections prepared by the Early Warning System.

IV. The Benefits of an Operational Early Warning System

The benefits of an operational early warning system unit would accrue to many persons and organizations. These would include government agencies, individuals seeking employment or better jobs, and firms attempting to fulfill government contracts on time and with minimum costs.

The Employment Service would be a primary beneficiary of an Early Warning System because of the advance notice it would receive of job openings which could frequently be regarded as among the better paid openings in its labor market area. Advance knowledge of these openings in specific occupations would make it possible to more effectively plan placement or training programs and to undertake special testing and counselling efforts to improve the Service's matching of workers and jobs. The Early Warning System unit could also assist the Employment Service and local Unemployment Insurance offices by providing them with information indicating when work on Federal contracts was expected to be completed and when major lay-offs were likely to occur. This information would provide the basis for special job development efforts to find employment for workers who would be laid off.

An operational early warning system could also assist the Office of Federal Contract Compliance in negotiating better Affirmative Action Plans because the System would supply the OFCC with knowledge about future job openings in specific occupations at particular establishments. Currently, Affirmative Action Plans are based on information on projected employment supplied by firms, and the Office of Federal Contract Compliance lacks an independent data source for judging the degree to which the plans submitted will help to implement Federal Equal Employment Policy. The Early Warning System data could make it possible to identify opportunities for increasing and upgrading job opportunities for women, older workers, or members of minority groups without dislocating the current work force.

Government procurement activities could also benefit from an effective ongoing early warning system. By assisting in assuring a supply of workers with the requisite skills, the system could help avoid manpower bottlenecks at contractors' plants, and thus reduce the likelihood of the cost overruns and production delays stemming from manpower-related bottlenecks. Large government contracts frequently involve substantial increases in manpower requirements in individual establishments on short notice. Similarly, the firms holding the contracts could avoid many costly staffing problems and improve their ability to produce on schedule by requesting that special manpower programs be established to insure that workers with the requisite skills will be available when needed. And, the Early Warning System would improve the functioning of local labor markets by making it feasible to more effectively match workers with manpower needs. The increases in wage rates in other firms, or the "pirating" of workers which sometimes takes place when establishments receiving substantial government contracts must hire many new employees on short notice, would be avoided. The skills added to the local work force through the training received or work experience in the firms holding the contracts would increase the mobility and the skill resources of the local labor force for many purposes other than the specific contract for which they were initially hired.

Most importantly, wage earners would benefit from the Early Warning System through greater opportunities for employment, for better earnings, or for upgrading. The larger Federally funded contracts are typically in industries paying better than average wage rates such as the aerospace, electronics, shipbuilding, or construction industries. In the Pullman-Standard contract, for instance, entry level laborers are paid $3.63 an hour, materials handlers are paid $3.73 an hour, while fitters "with some related experience" begin at $4.32 an hour. More difficult to illustrate with quantitative examples, but equally real, are the numerous opportunities for upgrading when firms must expand their work force on short notice.

There are probably well in excess of a hundred major Federal procurements each fiscal year. In the Corps of Engineers alone, the 1974 fiscal year budget identifies approximately 40 projects costing in excess of

$100 million, including seven projects in excess of $400 million. Additional numbers of multi-million dollar awards are made by other government agencies, including the Department of Defense and others described in Appendix II. This is certainly a substantial number warranting an early warning system.

APPENDIX I

METHODOLOGICAL APPENDIX

The purpose of this appendix is to map in greater detail the precise data, methodology and projection techniques used for the awards studied. This is done for several reasons. First, it provides a "handbook", which should be invaluable if the Department of Labor decides to initiate an Early Warning System (EWS) as one of its regular functions. Second, it allows other individuals in and out of the Department of Labor to replicate the study, one of the tests of a sound methodology. Finally, it allows students of manpower planning and projections to scrutinize and evaluate the procedures used.

With these objectives in mind, the appendix expands on the discussions of data, data sources and projection procedures discussed in Chapters I and II, and presents a step-by-step display of the data and the procedures employed in each of the contracts investigated. While this format is necessary for the purpose outlined above, it should be remembered that the techniques and procedures followed in each award have a common thread in the overall conceptual approach used as described in the introductory chapter of the report. This approach involves: projecting future outlays for the award; deriving a manpower coefficient (e.g., number of workers for every $1 million of expenditures) which relates manpower to the dollar figures; projecting the individual occupations needed over time; and adjusting the results for such items as deaths, retirements and discharges. The end result desired is to obtain projections of job openings by occupation so that manpower programs can have the necessary lead time to respond.

During our investigations we explored every possible avenue in seeking data. Much more data was collected than was eventually utilized. Some data was disgarded because better information was obtained; other data was not utilized because it was termed unreliable or because it did not fit into the projection procedures ultimately used. What is presented in this appendix is the "end product" of the system as it relates to the awards. It is our belief that the procedures used would apply to all major Corps of Engineers and NASA procurements and a large number of UMTA grants.

I. The Smithland Project

Introduction. The project at Smithland is for the construction of a lock and dam complex on the Ohio River, which runs between Illinois and Kentucky near Paducah, Kentucky. The Smithland project is one of about a dozen such projects planned to facilitate navigation along the river. While some of the sites are built to provide hydro-electric power, Smithland is not.

Total project cost is estimated at $199 million, of which $48.5 million had been spent by the end of fiscal year 1973.[1/] The lock portion of the project, which is contracted for separately, was awarded to a consortium of three firms, Dravo, Groves, and Newburg, and was for $86 million. The contract for the dam is expected to be let before the start of the 1975 fiscal year.

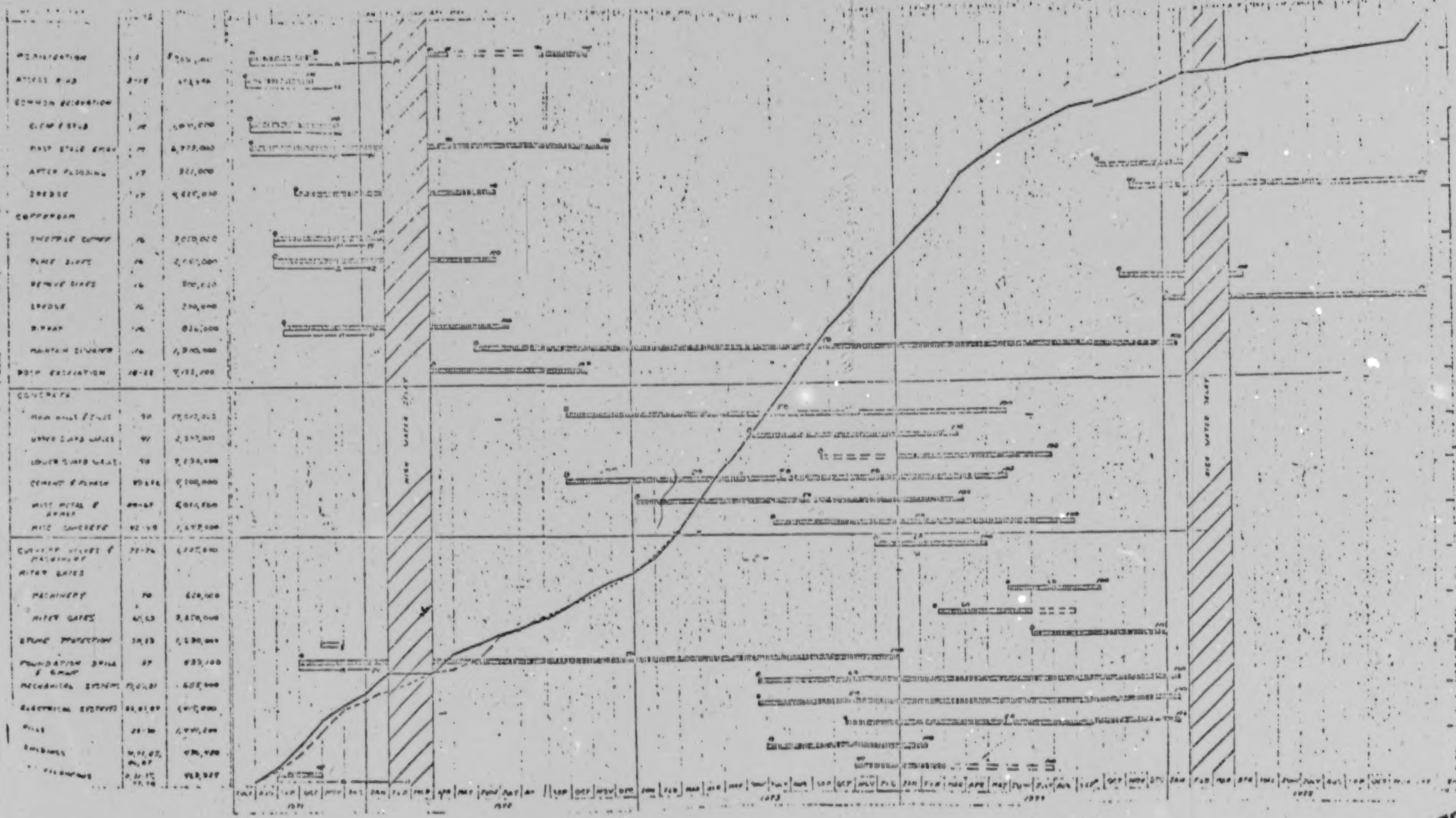
1/ The Budget of the United States Government, Fiscal Year 1974, Appendix, p. 348.

Data and Data Sources. The first step in the data gathering effort was to contact the Directorate of the Army Corps of Engineers in Washington. Discussions with the Directorate indicated that two projects were most likely to undergo employment increases: the New Mellones lock and dam, and the Smithland lock and dam. While Mellones was somewhat more desirable because it was in the very early stages of work, court action related to environmental impact was holding up construction. We therefore went with Smithland. We next contacted the Corps' Nashville District Office which had administrative responsibility for the Smithland project. From the Construction Division at Nashville we obtained a copy of the "contractor's schedule," learned of the existence of monthly "work progress" reports, and obtained their projection of total monthly contractor payments for the duration of the contract. Copies of the monthly work progress reports were later secured through the data processing chief at the district office. The Engineering Division provided a copy of the original Corps estimate of costs, called a "reasonable contract estimate". Through the District Council we were able to obtain several payrolls for the project which had been filed with the office to comply with the Davis-Bacon Act. The paragraphs below describe the data:

Contractor's Schedule: contains information on the total cost of related work items and the expected percentage of each task to be completed monthly during the contract. Figure 1 (following this page) shows a copy of this schedule for Smithland.

Figure 1

Contractor's Schedule for the Smithland Project



BEST COPY AVAILABLE

Work Progress Reports: contain figures for the actual dollars earned to date by work item. By subtracting the earnings from those of the previous month, monthly earnings by work item can be obtained. Figure 2 (following this page) shows a copy of a month's report from Smithland.

Monthly Earnings Projections: contain projections of total monthly disbursements to the contractor under assumptions of early, average and late finish scenarios. These projections are updated quarterly. Figure 3 shows the projected contractor earnings for the next three fiscal years at Smithland.

Reasonable Contract Estimate: is a manual which lays out the job specifications for each work task, estimates the total, material and labor costs, and number of days needed to complete the task. It is drawn-up by the Corps' engineering staff prior to the soliciting of bids. A page from the Smithland estimate is shown in Figure 4.

Payrolls: weekly payrolls for the project filed with the contracting District Office contain data on the occupation, hours worked, and wage rate for each worker at the site. Figure 5 shows an extract from a Smithland payroll.

Figure 2

BEST COPY AVAILABLE

Work Progress Report for Smithland, September 1973

CONTRACTORS EARNINGS THROUGH 23 SEPTEMBER 1973 SMITHLAND LOCKS

BID ITEM	CONTRACT AMOUNT	EARNINGS TO DATE	PERCENT COMPLETE	BID ITEM	CONTRACT AMOUNT	EARNINGS TO DATE	PERCENT COMPLETE
1	7556000.	6566674,	59	46	252000,	0,	0
2	210900,	155650,	74	47	128000,	0,	0
3	0,	0,	0	48	122500,	0,	0
4	453486,	311037,	69	49	4405673,	2708169,	61
5	0,	0,	0	50	1509494,	938151,	62
6	0,	0,	0	51	27109,	10873,	40
7	0,	0,	0	52	186921,	134235,	72
8	0,	0,	0	53	25000,	2870,	11
9	0,	0,	0	54	310000,	0,	0
10	0,	0,	0	55	125000,	71982,	58
11	0,	0,	0	56	1500000,	406629,	27
12	0,	0,	0	57	10000,	265,	3
13	0,	0,	0	58	50000,	1779,	4
14	0,	0,	0	59	400000,	150128,	38
15	1000000,	950000,	95	60	180000,	32203,	18
16	8036000,	5995530,	75	61	60000,	0,	0
17	12325000,	5932467,	48	62	7000,	0,	0
18	4500000,	4862773,	108	63	180000,	90353,	50
19	474000,	316277,	67	64	50000,	1823,	4
20	110000,	6000,	5	65	75000,	23784,	32
21	135500,	37043,	27	66	30000,	7263,	24
22	433600,	315144,	73	67	265098,	0,	0
23	39000,	5100,	13	68	380000,	79433,	21
24	600000,	202025,	34	69	2870000,	17600,	1
25	374400,	21060,	6	70	620000,	-0,	0
26	0,	0,	0	71	600,	0,	0
27	0,	0,	0	72	880,	0,	0
28	146430,	0,	0	73	620000,	27143,	4
29	103434,	0,	0	74	350000,	0,	0
30	4800,	0,	0	75	125000,	0,	0
31	16200,	0,	0	76	300000,	178398,	59
32	9000,	0,	0	77	30000,	15789,	53
33	1000,	0,	0	78	165000,	11956,	6
34	7000,	0,	0	79	470000,	56480,	12
35	10000,	0,	0	80	75000,	13955,	19
36	0,	0,	0	81	140000,	28334,	20
37	599100,	396276,	66	82	1260000,	64083,	5
38	1390000,	82360,	6	83	15000,	0,	0
39	300000,	0,	0	84	140000,	0,	0
40	25936520,	17644885,	69	85	425000,	6145,	1
41	2945292,	151410,	5	86	60000,	0,	0
42	530000,	26350,	5	87	10000,	0,	0
43	344000,	0,	0	88	-716000,	-357355,	0
44	0,	0,	0	89	25975,	12964,	50
45	220000,	11000,	5	90	11175,	0,	0

TOTAL BID AMOUNT $ 86055087,
EARNINGS TO DATE $ 49019893,
PERCENT COMPLETE 57%

BEST COPY AVAILABLE

Figure 3

```
COST SCHEDULE FOR SMITHLAND AS OF 19 JAN 1973

FISCAL YEAR 1974

  MONTH          EARLY FINISH         AVERAGE FINISH         LATE FINISH
                 COST     PERCENT     COST     PERCENT      COST     PERCENT
JULY          55301061,    66.0    47850143,    57.1     40399224,    48.2
AUGUST        61407164,    73.3    53294678,    63.6     45182093,    53.9
SEPTEMBER     64531729,    77.0    57256096,    68.3     49980463,    59.6
OCTOBER       67219494,    80.2    60898926,    72.7     54578358,    65.1
NOVEMBER      69408049,    82.8    63722083,    76.0     58036116,    69.3
DECEMBER      71054047,    84.8    65801974,    78.5     60549901,    72.3
JANUARY       72578377,    86.6    67645886,    80.7     62713396,    74.8
FEBRUARY      73809109,    88.1    69219252,    82.6     64629396,    77.1
MARCH         74747989,    89.2    70831340,    84.5     66914691,    79.9
APRIL         75207542,    89.8    71885580,    85.8     68563617,    81.8
MAY           75926718,    90.6    72620640,    86.7     69314574,    82.7
JUNE          76910428,    91.8    73449731,    87.7     69989035,    83.5

FY TOTAL      25403399,            29764894,             34126388,

FISCAL YEAR 1975

  MONTH          EARLY FINISH         AVERAGE FINISH         LATE FINISH
                 COST     PERCENT     COST     PERCENT      COST     PERCENT
JULY          78022722,    93.1    74409945,    88.8     70797168,    84.5
AUGUST        78890873,    94.2    75130230,    89.7     71369587,    85.2
SEPTEMBER     79499360,    94.9    75599521,    90.2     71699681,    85.6
OCTOBER       79832381,    95.3    75859846,    90.5     71887312,    85.8
NOVEMBER      80235689,    95.8    76158267,    90.9     72080845,    86.0
DECEMBER      80985407,    96.7    76650854,    91.5     72316300,    86.3
JANUARY       81610919,    97.4    77105205,    92.0     72599491,    86.6
FEBRUARY      81817441,    97.6    77380984,    92.4     72944526,    87.1
MARCH         82046090,    97.9    77722413,    92.8     73398735,    87.6
APRIL         82256677,    98.2    78047499,    93.1     73838321,    88.1
MAY           82443915,    98.4    78378796,    93.5     74313677,    88.7
JUNE          82625113,    98.6    78704531,    93.9     74783949,    89.3

FY TOTAL       5714685,             5254800,              4794915,

FISCAL YEAR 1976

  MONTH          EARLY FINISH         AVERAGE FINISH         LATE FINISH
                 COST     PERCENT     COST     PERCENT      COST     PERCENT
JULY          82812351,    98.8    79037250,    94.3     75262150,    89.8
AUGUST        82999589,    99.1    79491641,    94.9     75983692,    90.7
SEPTEMBER     83180787,    99.3    80203835,    95.7     77226883,    92.2
OCTOBER       83368025,    99.5    80985337,    96.7     78602649,    93.8
NOVEMBER      83549223,    99.7    81617354,    97.4     79685485,    95.1
DECEMBER      83736461,    99.9    82341959,    98.3     80947457,    96.6
JANUARY       83790690,   100.0    83790690,   100.0     83790690,   100.0
FEBRUARY      83790690,   100.0    83790690,   100.0     83790690,   100.0

FY TOTAL       1165577,             5086159,              9006740,
```

Figure 4

BEST COPY AVAILABLE

Reasonable Contract Estimate for Smithland

[illegible] SHEET 1 OF [illegible]

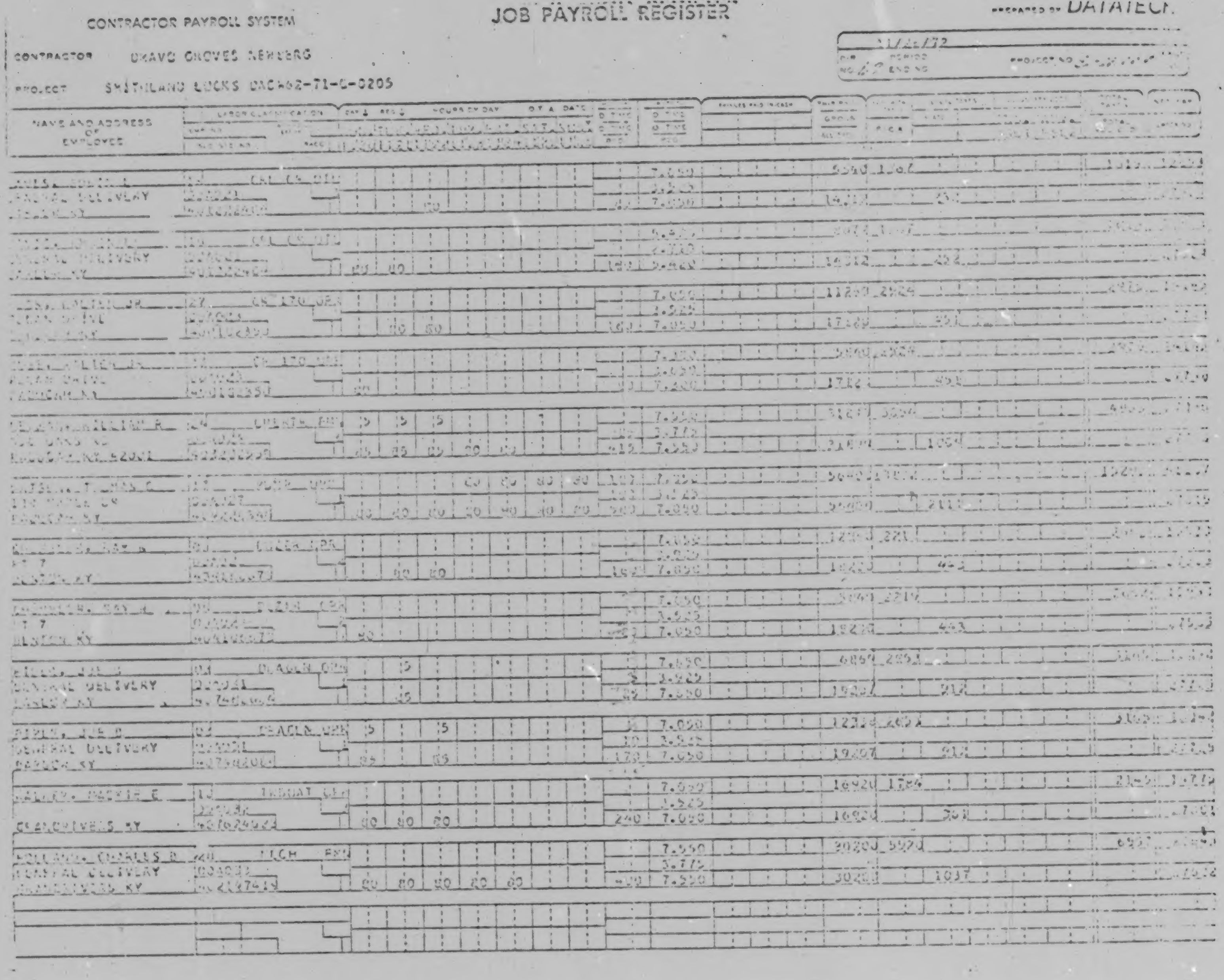
[illegible]						
[illegible]					[illegible]	
[illegible]	[illegible]	[illegible]	MATERIALS	[illegible]	SUBTOTAL	REF.
A. [illegible] ✓	[illegible]	[illegible]	—		112,915	
B. [illegible] ✓	[illegible]	[illegible]	463,552		[illegible]	
C. [illegible] ✓	[illegible]	[illegible]	[illegible]		3,254,549	
D. [illegible] ✓				[illegible]311,800	4,311,[illegible]	
E. [illegible] ✓	[illegible]	[illegible]	—		77,86[illegible]	
F. [illegible]	—	71,836	[illegible]		75,4[illegible]	
G. [illegible] ✓	[illegible]	[illegible]	[illegible]		295,[illegible]	
H. [illegible]	18,[illegible]	[illegible]	[illegible]		72,126	
I. [illegible]	9,500	1,500	[illegible]		48,900	
J. [illegible]	230,571				230,571	
K. [illegible]				1800	1,800	
L. [illegible]	985	15,3[illegible]	[illegible]		[illegible]	
M. [illegible]				6,800	6,800	
N. [illegible]				[illegible]	1,311,220	
O. [illegible]	9,070	36,522		57,996	103,5[illegible]	
P. [illegible] ✓	309,[illegible]	[illegible],541			521,198	
Q. [illegible] ✓	[illegible]	183,0[illegible]	—		339,[illegible]	
R. [illegible] ✓	[illegible]	[illegible]	—		[illegible]	
S. [illegible]	—	—	6,000		[illegible]	
T. [illegible]	[illegible]	[illegible]	—		195,[illegible]	
U. [illegible] System				70,000	70,000	
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	12,415,1[illegible]	

[illegible] REPLACES EDITION [illegible] OBSOLETE [illegible]

Page [illegible]

BEST COPY AVAILABLE

Figure 5



JOB PAYROLL REGISTER

CONTRACTOR PAYROLL SYSTEM

PREPARED BY DATATECH

CONTRACTOR UKAVO GROVES NEWBERG

PROJECT SMITHLAND LOCKS DACW62-71-C-0205

Projection Procedures for the Smithland Locks. The projection procedure ultimately employed involved applying the manpower experience of a completed lock project in the same geographic area and in a similar work phase as the upcoming work at Smithland. Weekly payrolls and monthly work progress reports for a twelve-month period for the Uniontown lock project were obtained from the Louisville District Office.

The specific steps in the procedures were as follows:

1. Determining the relationship between occupational manpower requirements and expenditures by work item for the Uniontown project;
2. Adapting this relationship for differences in wage rates, materials costs, profit margins, and similar variables between Uniontown and Smithland;
3. Projecting future monthly outlays at Smithland by work item;
4. Applying the occupational manpower coefficients as adjusted in #2 to the projected Smithland outlays in #3; and
5. Converting man-hours into full-time equivalent workers.

1. Determining the relationship between manpower and expenditures:

One Uniontown payroll was obtained for each month during 1967, when the major work at the Uniontown lock (the pouring of concrete) was comparable to the projected work at Smithland for fiscal year 1974. Only one payroll per month was used, to reduce the amount of data collection required. The expectation was that one payroll would be reflective of the manpower requirements for that month. Inclement weather, flooding and other such disturbances can affect the man-hours of work in a particular week or month. For this reason, two months in which the weekly payrolls showed significant decreases in man-hours of work while the monthly work progress reports showed increases in expenditures had to be dropped from the data input. Two other months were excluded because no work was performed due to weather conditions. Eight months from Uniontown were therefore available for analysis.

First, the man-hours reported on the payrolls were aggregated by occupation. Six occupations were identified as containing the bulk of the work force: carpenters, laborers, operating engineers, teamsters, oilers and greasers, and mechanics. Man-hours were used rather than actual employment figures for several reasons. First, man-hours should be a better measure of work effort than employment. This is because of the possibility of offsetting a reduction in expenditures by reducing the number of overtime hours rather than decreasing the number of workers. In fact, several computer runs were made with employment, rather than man-hours, as the dependent variable, and the resulting measures of correlation and significance were not as high as when man-hours were used. Another reason for working with man-hours and not employment is that a particular worker may be classified in several occupations during a week (i.e., he may work 20 hours as a laborer and 25 hours as a carpenter). This brings up a problem as to where to classify the individual in terms of occupation. By using man-hours, this difficulty is eliminated, as the man-hours he works are simply placed in the appropriate occupation. Additionally, some workers work only a few hours during the week. Is this individual to be treated as a "whole" worker or as only a "fraction" of a worker, depending on the number of hours worked relative to the average work week? Using man-hours also eliminates this problem.

The monthly work progress reports for the year at Uniontown indicated that, while eight "work items" were being performed during the period, concrete work so predominated the outlays that statistically significant correlations using other individual work items could not be made because the standard error was so great as to render the coefficient unreliable. All work items other than concrete were therefore combined into an "other" category.

The data on man-hours for each occupation at Uniontown were regressed against the Uniontown expenditures by month using ordinary least squares formula. In the case of oilers and greasers and mechanics, the man-hours were regressed against the man-hours for operating engineers, as it was felt that employment of these workers would be most closely related to the number of heavy equipment vehicles being operated, and that the man-hours of operating engineers was a good surrogate measure. The resulting correlation coefficients were significant, as will be discussed below. The equation used was of the general type: man-hours in occupation Z = k(expenditures for work item w), where man-hours is considered the dependent variable and expenditures on the work item is the independent variable. The k term is the coefficient which, when multiplied by expenditures, will indicate man-hours in the occupation of the dependent variable. For oilers and greasers and mechanics, man-hours of operating engineers was used as the independent variable. The equations used for each occupation are shown in Table 1.

Table 1

Equation Representing the Relationship Between Man-Hours And Expenditures, By Occupation

Dependent Variable	=	Coefficient	X	Independent Variable
Total Project Man-Hours		32.5		Total Project Expenditures (in thousands)
Carpenter Man-Hours		12.2		Concrete Expenditures (in thousands)
Teamsters Man-Hours		1.8		Concrete Expenditures (in thousands)
Laborer Man-Hours		14.7		Concrete Expenditures (in thousands)
Operating Engineers (1)		3.6 3.0 & 3.0		a) Concrete Expenditures (in thousands) b) Concrete Expenditures and "Other" (in thousands)
Oilers and Greasers		.5449		Operating Engineers Man-Hours
Mechanics		.4551		Operating Engineers Man-Hours

---

(1) Two equations were used to project operating engineers, depending on the work being performed. This point will be discussed further in the section on applying the coefficients to the dollar expenditures.

It should be remembered that the independent variable is in terms of monthly expenditures (in those cases where expenditures are used), while the dependent variable is in terms of average weekly man-hours for the month These coefficients were translated into monthly man-hours by multiplying by the number of weeks per month (4.3) for presentation in Chapter II of the report.

The following figure (Figure 6) shows the data input, correlations, measures of significance for the equation, and the actual and predicted values using the equation for carpenter man-hours.

BEST COPY AVAILABLE

Figure 6

Data Input and Regression Results for Carpenter Man-Hours

```
DEPENDENT VARIABLE FOLLOWED BY INDEPENDENT VARIABLES--

INDEX NO.   TRANSFORM   ABBREVIATION   NAME

     2                  CARP           CARPENTER M/H UNIONTOWN
             NONE
     3                  CONE           CONCRETE EXP UNIONTOWN
             NONE
     4                  CONE


  AVERAGES AND STANDARD DEVIATIONS
                        CARP        CONE
     1                  2.689     395.240
     2                  3.915     395.240
     3                  1.461     197.620
     4                  5.800     656.245
     5                 10.967     707.050
     6                 11.615     810.525
     7                 11.987     899.290
     8                 11.187     988.100

  AVG                   7.452     631.163

  STD        2.         4.153     259.117

   SUM OF SQUARES OF Y DEVIATIONS FROM THE MEAN =        138.019


   SIMPLE CORRELATION COEFFICIENTS
          1      2      3
     1  1.000  0.889  0.901
     2  0.889  1.000  0.938
     3  0.901  0.938  1.000

   SUM OF SQUARED WEIGHTS =      8.00


                                       STD ERROR OF ESTIMATE =            1.74714
        CARP   FIT
        CORRECTED R SQUARE=  0.8451     F=    38.21   SIGNIFICANCE OF F =  0.9995

VARIABLE NAME             CONE
COEFFICIENT               0.0122
STANDARD ERROR            0.0009


     MEAN               E(RHO)
     ERROR             -0.293929

ANALYSIS  OF  RESIDUALS

     OBSERVATION     SQUARED    OBSERVED         CALCULATED     RESIDUAL
     NUMBER          WEIGHT     VALUE            VALUE          VALUE

             1        1.000       2.689000        4.850957      -2.161957
             2        1.000       3.915000        4.850957      -0.935957
             3        1.000       1.461000        2.425478      -0.964478
             4        1.000       5.800000        8.054388      -2.254388
             5        1.000      10.967000        8.677940       2.289059
             6        1.000      11.615000        9.947935       1.667064
             7        1.000      11.987000       11.037388       0.949611
             8        1.000      11.187000       12.127392      -0.940392

WEIGHTED  MEAN                    7.452625        7.746554      -0.293929
WEIGHTED  MEAN  SQUARE           72.794114       70.123170       2.670944
```

The corrected R squared indicates that 84.5 percent of the variation in the dependent variable (carpenter man-hours) is explained by changes in the independent variable (concrete expenditures). The closer this value (R squared) is to 100.0 percent, the greater the reliability of the coefficient. Another measure of the "goodness of fit" is the "F" values, which tell whether the results obtained are better than would have resulted if the mean observed value was substituted for the regression calculated value. The significance of F for the carpenter equation is .9995, showing that the regression coefficient was a much better measure than the mean. The following table gives the corrected R squared for the equations, the F values and their significances.

Table 2

Corrected R Squared, F Values and Significance of F Values For Regression Equations of Uniontown Occupational Man-Hours

	Corrected R Squared	F Value	Significance of F Value
Total Man-Hours	.858	42.32	.9996
Carpenter Man-Hours	.845	38.21	.9995
Teamster Man-Hours	.733	19.24	.9967
Laborer Man-Hours	.867	45.45	.9997
Operating Engineer Man-Hours	.812	30.17	.9990
Oiler/Greaser, Mechanic Man-Hours	.908	68.87	.9999

Based on these results, it can be stated with confidence that certain relationships do exist between the man-hours of work by occupation and the level of expenditures on key work items, and that these relationships should form a solid basis for projecting man-hours of effort on other projects.

2. Adapting the manpower coefficients for use at Smithland:

Before the coefficients from one project can be applied to another one, certain factors must be taken into account. These factors include changes in wage rates, materials costs, profit margins, subcontracting arrangements which alter the direct labor proportion, productivity, and other related variables. For example, the average wage for carpenters, the predominant occupation, was \$5.01 in July 1967 and \$7.44 in July 1972 in the United States.[1/]

It was determined that the best way to adjust for these factors would be to compute the ratio of average outlays per worker at Smithland to the average outlays per worker at Uniontown, and to apply this ratio to the individual occupational coefficients. In this way no complicated "deflator" needed to be developed and the factors not taken into account by a deflator such as productivity and subcontracting arrangements would also be included in the adjustment factor, eliminating the need for additional adjustments.

Average monthly outlays per worker at Smithland during the first six months of 1973 were one third the average outlays per workers at Uniontown for the eight months of 1967 used in the regression. The occupational coefficients derived from the regression were, therefore, multiplied by .33

[1/] U. S. Department of Commerce, Construction Review, February 1973, p. 49.

before being applied to the dollar outlay independent variables. For oilers and greasers and mechanics, the .33 factor did not have to be applied since the independent variable was not dollars, but man-hours of operating engineers.

3. Projecting future monthly earnings at Smithland:

Projecting the monthly outlays by the contractor involves the following three steps:

a. Obtaining the total monthly outlays projections from the Corps District Office;

b. Adjusting the monthly figures above to conform with the most recent budget estimate of appropriations for the project as published in the Appendix to The Budget of the U.S. Government;

c. Dividing each month's outlays into individual work item expenditures.

It is important to begin with the Corps' monthly projections because these take into account many factors which would otherwise be difficult to adjust for. For example, the proportion of the yearly appropriation spent in a particular month depends on the phase of work, the type of weather expected (e.g., flooding during the spring), etc. These monthly outlay figures, when totalled for the fiscal year, are generally close to the latest budget appropriation estimate for the project. The budget estimate is obtained from the detailed Corps of Engineers budget in the Appendix to The Budget of the U.S. Government. The adjustment is therefore minor, but it maintains consistency and should improve the accuracy of the projections. The monthly outlays are divided into spending on individual work items based on the "contractor's schedule." Table 3 shows this process.

Although use of the "reasonable contract estimate" manual is not specifically included in the projection procedures, it can be a valuable document to obtain. First, the manual provides some identification of occupations associated with particular work items. This can be of value in determining which occupations to regress against which work items, and helps eliminate spurious correlations. Second, it describes each task and sub-task and helps to relate the work items from one project to another to be sure they are consistent.

4. Applying the adapted occupational manpower coefficients to the projected dollar expenditures:

Once the projected dollar outlays and the relationship between man-hours and expenditures have been determined, the coefficients, as modified above, are applied to the projected expenditures. The oilers and greasers and mechanics coefficient is applied to the projected man-hours for operating engineers. As shown in Table 1, two estimating equations were used for operating engineers. The first utilized only "concrete" as the independent variable for determining the number of man-hours. The second used both "concrete" and all "other" expenditures. The "concrete" equation was used for the first half of 1974, when concrete outlays are expected to account for substantial portions of the monthly outlays for the locks, while the "concrete" and "other" equation was

Table 3

Projections of Monthly Outlays at Smithland by Major Work Item, FY 1974
(thousands of dollars)

Fiscal Year 1974	Initial Corps Projection of Outlays	Corps Projection Adjusted to Budget Control Total	Proportion of Outlays for Major Work Items: Concrete	Miter Gates	Wall Armor	Other
July 1973	$ 4,536.5	$ 3,256.9	80%	0%	13%	7%
August	4,782.8	3,433.7	80	0	13	7
September	4,798.3	3,444.8	80	0	14	6
October	4,597.7	3,300.8	80	0	14	6
November	3,456.9	2,481.8	83	0	15	2
December	2,513.8	1,804.7	66	0	13	21
January 1974	2,163.4	1,553.2	69	0	9	22
February	1,916.1	1,375.6	75	0	10	15
March	2,285.3	1,640.7	64	15	9	12
April	1,648.9	1,183.8	74	18	0	8
May	750.9	539.1	79	19	0	2
June	674.4	484.2	59	37	0	4
Total Fiscal Year	34,126.0	24,500.0	76	3	12	8

used for the second half of 1974, when concrete expenditures are expected to be at a lower level and "other" expenditures would therefore be more important as a determining variable.

5. Translating man-hours into workers:

The final step in obtaining employment estimates is to translate the weekly man-hours figures into the number of workers needed. Man-hours had been used in the regression analysis because they were found to be more "sensitive" to changes in expenditures than was the absolute number of workers. By dividing the total man-hours in each occupation by an average hourly work week figure, a "full-time equivalent" work force is derived. For those months where average weekly man-hours in an occupation were projected to exceed 1,250, a 46-hour week was used. When the projected man-hours fell below 1,250, a 40-hour week was assumed. The 46-hour week is the equivalent of an average of 15 percent overtime on top of a 40-hour week. This was done based on examination of the average man-hours per worker in the various occupations at Uniontown and Smithland. It was noted that when total man-hours dropped significantly there was a tendency for the average man-hours per worker to decline. Also, when the man-hours in an individual occupation fell below a particular level, average man-hours per worker tended to be lower. This ocurred at about 1,250 man-hours, or with about 30 workers in the occupation.

Projection Procedures for the Smithland Dam. With construction of the locks sufficiently progressed, work on the dam is slated to begin at the start of the 1975 fiscal year. The Corps is currently completing its "reasonable contract estimate" and expects to invite bids shortly. It is therefore important to make projections for the dam as well as the locks. As employment on the locks declines, it may be possible for many of the lock workers to be shifted to work on the dam. The degree of transferability is likely to be limited, however, because of the differing work activities involved in completing the lock and beginning the dam.

The procedures used to project occupational requirements for the dam involve the same basic steps as for the locks. These are:

1. Determining the relationship between total man-hours and total expenditures;
2. Projecting future monthly expenditures on the dam;
3. Applying the total manpower coefficient from #1 to the projected outlays in #2;
4. Distributing the total man-hours to individual occupations; and
5. Converting man-hours into full-time equivalent workers.

The only difference in the procedure was that occupation-specific man-hours coefficients could not be used because the precise amounts to be spent on each work item is not yet known. Total project man-hours were determined by using the coefficient derived for the locks. Man-hours figures for individual occupations were obtained by applying the percent distribution of man-hours by occupation from the early part of the Smithland lock work to the total project man-hours figure for the dam.

This procedure should result in accurate projections because the types of work in the early stages of the lock and the dam are the same, according to officials at the Corps District Office; both involving substantial earth-moving and the building of a cofferdam to hold back water during subsequent construction. The distribution used is, therefore, "project-specific" and need not be adapted or adjusted for productivity and other similar differences. Man-hours were converted into full-time equivalent workers by using the same guidelines as were used for the lock.

Monthly dollar outlays for the dam were projected in the same manner as they were for the lock. First, total outlays for the dam were projected. While the fiscal year 1975 budget is not yet available, officials at Nashville indicated that the total project appropriation (lock and dam) should be about the same as for 1974, about $24 million. Since it is known that about $7.7 million is needed to complete work on the locks, the remainder could be allocated to the dam. Second, the $16.8 million for the dam was apportioned into monthly outlays based on the distribution of outlays in the first year of the lock, since that year represented a comparable period in terms of work effort.

Results of the Smithland Projections. Table 4 shows the projected employment at Smithland by month and six-month averages for the January 1974 to June 1975 period. As can be seen, employment on the dam is scheduled to begin at the start of fiscal year 1975 (July 1974). What is of primary interest are the six-month average figures. Employment on the locks is expected to decline to an average of 192 during the July-December 1974 period, while employment on the dam will

BEST COPY AVAILABLE

Table 4

Projected Employment at Smithland, by Month and Six-Month Averages, January 1974 - June 1975

	1/74	2/74	3/74	4/74	5/74	6/74	6-Month Average	7/74	8/74	9/74	10/74	11/74	12/74	6-Month Average	1/75	2/75	3/75	4/75	5/75	6/75	6-Month Average
Total	363	321	383	277	145	130	270	786	698	632	610	543	538	634	421	No Employment - Shutdown Due to High Water Anticipated	No Employment - Shutdown Due to High Water Anticipated	510	540	509	330
Locks	363	321	383	277	145	130	270	364	298	172	97	100	122	192	146			229	247	244	144
Dam	-	-	-	-	-	-	-	422	400	460	513	443	416	442	275			281	293	265	186
Carpenters	94	91	93	78	43	29	71	86	47	50	53	49	48	55	41			14	15	13	14
Locks	94	91	93	78	43	29	71	62	27	27	27	27	27	33	27			-	-	-	5
Dam	-	-	-	-	-	-	-	21	20	23	26	22	21	22	14			14	15	13	9
Teamsters	14	14	14	12	7	4	11	52	44	50	55	48	46	49	32			28	29	27	19
Locks	14	14	14	12	7	4	11	10	4	4	4	4	4	5	4			-	-	-	1
Dam	-	-	-	-	-	-	-	42	40	46	51	44	42	44	28			28	29	27	18
Laborers	113	109	112	93	52	35	86	184	132	147	160	143	136	150	101			70	73	66	52
Locks	113	109	112	93	52	35	86	78	32	32	32	32	32	40	32			-	-	-	5
Dam	-	-	-	-	-	-	-	106	100	115	128	111	104	110	69			70	73	66	47
Operating Engineers	28	27	27	23	13	12	22	131	120	122	128	112	108	120	76			87	90	84	56
Locks	28	27	27	23	13	12	33	34	28	16	10	10	12	18	13			22	23	23	13
Dam	-	-	-	-	-	-	-	97	92	106	118	102	96	102	63			65	67	61	43
Oilers/Greasers	12	12	12	10	6	5	10	54	48	48	50	45	42	48	31			35	37	34	23
Locks	12	12	12	10	6	5	10	16	12	7	4	5	5	8	6			10	11	10	6
Dam	-	-	-	-	-	-	-	38	36	41	46	40	37	40	25			25	26	24	17
Mechanics	15	15	15	12	7	7	12	64	60	59	61	54	52	59	37			43	44	41	27
Locks	15	15	15	12	7	7	12	18	16	8	5	5	6	10	7			12	12	12	7
Dam	-	-	-	-	-	-	-	46	44	51	56	49	46	49	30			31	32	29	20
All Others	87	53	110	49	17	38	58	218	247	156	103	92	106	153	103			233	252	244	139
Locks	87	53	110	49	17	38	58	146	179	78	15	17	36	78	57			185	201	199	107
Dam	-	-	-	-	-	-	-	72	68	78	88	75	70	75	46			48	51	49	32

average 442. Total employment at the site is expected to average 634, significantly above the prior six-month average of 270 workers, when only work on the locks was underway. However, the following six months, January to June 1975, should show a decline. February and March are expected to be a period of high water (see contractor's schedule), during which work cannot be performed. April, May and June are the last quarter of the fiscal year, when the contractor is traditionally low on appropriated funds and must wait for the next fiscal year's appropriation. The occupational figures for this period should be regarded as tentative, because the specific work tasks for the dam are not yet known and the cofferdam, which forms the basis for the occupational details, will be nearing completion.

The six-month average figures are preferable to the monthly projection figures for a number of important reasons. First, occupational requirements can vary considerably from month to month in the heavy construction industry, and it would therefore be unwise for manpower planners to be concerned with training workers for jobs which may be needed for only a month or two. Second, monthly projections are likely to be subject to a greater degree of error than an average of six months. This is especially true when factors such as flooding can occur and upset construction plans for several months. Use of the average for the period lessens the degree to which these factors can affect the projections.

Of additional interest is the occupational distribution of employment. Table 5 shows the occupational distribution for the six-month averages. Aside from showing changes in the total employment level, which is a function of monthly outlays, the table illustrates how sharply occupational trends change as the nature of the work changes. The percentage of workers employed as carpenters declines by two thirds during the first and second six-month periods, while the proportion of operating engineers more than doubles.

Another important conclusion which can be drawn from the occupational distributions is that even if total employment is unchanged over time, there can be significant numbers of job actions (hires and lay-offs) as the "mix" of skill needs changes. If, for instance, total employment remained unchanged at 500 during the first and second six-month periods, while there would be no change in overall employment, employment of carpenters would decline from 132 to 44 and operating engineers would increase from 41 to 95.

These changes underscore the need to analyze manpower requirements relative to the work being done, and point up one of the weaknesses of using "aggregative" or industry data for occupational patterns. Such data represent the agglomeration of all similar firms at different stages of production using various production technologies. The "average" which arises from this data can be very different than the firm being investigated.

Table 5

Percent Distribution of Occupations, Smithland, Six-Month Averages, January-June 1974, July-December 1974, January-June 1975

	Average Jan.-June 1974	Average July-Dec. 1974	Average Jan.-June 1975
Carpenters	26.3%	8.7%	4.2%
Teamsters	4.1	7.7	5.7
Laborers	31.9	23.7	15.8
Operating Engineers	8.1	18.9	17.0
Oilers/Greasers	3.7	7.6	7.0
Mechanics	4.4	9.3	8.2
All Others	21.5	24.1	42.1
Total	100.0	100.0	100.0

In 1960, the Bureau of Labor Statistics analyzed the man-hours by occupation for a representative sample of the Corps of Engineers Civil Works Project.[1/] Among the 28 "land" projects were five dams (only one was concrete). The distribution of on-site man-hours for the 28 land projects in the study is shown below:

Carpenters	6.4%
Teamsters	14.0
Laborers	22.9
Operating Engineers	24.1
Oilers/Greasers	7.7
Mechanics	4.8
All Other	20.1
Total	100.0

[1/] U.S. Department of Labor, Bureau of Labor Statistics, Labor and Material Requirements for Civil Works Construction by the Corps of Engineers, Bulletin No. 1390, 1964. BLS is currently performing a similar study based on the 1970 Corps program.

These 28 projects not only represent various types of projects (e.g., dams, levies, pile dikes, bank stabilization, flood protection, etc.),[1] but all the projects were completed during 1960. This means that the distribution of man-hours is not only weighted according to type of projects but also skewed toward the distribution during the final stages of work.

It is clear that application of the man-hours distribution from the BLS study to Smithland would yield substantially different projections of manpower needs over the eighteen months than is shown in Table 4. A constant distribution of man-hours would also have to be employed, which could lead to the underestimating of employment opportunities as the work progressed from one phase to another.

The projections as shown in Table 4 are full-time equivalent jobs. They do not take into account turnover, which in the construction industry can be substantial. For example, total employment at Smithland is expected to increase by 364 from the January-June 1974 average to the July-December 1974 average. If labor turnover amounted to 3 percent a month from July to December, the number of new hires would increase by an additional 115, or by one third of the projected new job slots. The BLS does not collect data on turnover in the construction industry and there is therefore no benchmark data on which to base a rate. Annual deaths and retirements in various construction crafts (e.g., carpenters, laborers, and operating engineers) run between 1 and

---

[1] Seventeen dredging projects were also studied, and the distribution of man-hours for these are presented separately from the 28 "land" projects.

2 percent annually.[1]

The work force on a construction project of this nature is not really a "stock" of workers. There is a continuous "flow" of workers into and out of a project. Several hundred carpenters may be needed during the first part of a year and perhaps only fifty during the middle portion. When several hundred are again needed at the end of the year they are not likely to be the same individuals who were laid off at the beginning of the period. However, an adjustment for turnover consistent with the BLS data on deaths and retirements for the appropriate occupations was made in presenting the projections in Chapters I and II. This was done primarily to be consistent with the projections for the other awards.

Updating the Projections. Experience has shown that projections may need to be revised to take account of government change orders, changes in the level of appropriations, production delays, and other related factors. At Smithland the major source of delays is the weather. The high water levels during February and March may bring work to a halt. Excessively high water can cause the cofferdam to be breached and may mean a delay of several months until the damage is repaired. Because the engineering specifications are detailed, change orders are not generally substantial.

The monthly work progress reports are a key element in updating the projections. If the contractor is spending less than projected in the early part of the year, he can be expected to make up this shortfall during the latter part, if at all possible, by hiring additional workers, increasing overtime, or both. A shortfall in the early part of a fiscal year, therefore, would be proportionally reallocated to the remaining months for the year. On the other hand, if the contractor is substantially ahead of the expected level of expenditures, he may run out of funds before the end of the fiscal year, and monthly projections for the remainder of the year would need to be scaled downward, although there is also a possibility of redirecting other Corps funds to such a project. Information which will permit such adjustments are available from the appropriate Corps district office.

---

[1] U.S. Department of Labor, Bureau of Labor Statistics, Tomorrows Manpower Needs, Vol. 1, Bulletin 1606, 1969.

Testing the Manpower Coefficients. Is the use of coefficients of man-hours per thousand dollars of expenditures derived from a previous project actually transferable to another one? The adapted coefficients were tested retrospectively by applying them to the actual data for two months in 1973. The dollar expenditures for March and May were taken from the monthly work progress reports at Smithland, and one payroll for each month was obtained from the Corps to reflect the man-hours by occupation for those months. The period selected for the test was also one which was comparable to the historical Uniontown data, as the pouring of concrete at Smithland began in late 1972 and is scheduled to be completed in mid-1974.

Table 6 compares the actual and predicted man-hours for March and May of 1973. It can be seen that the predicted values are more

Table 6

Comparison of Actual and Predicted Man-Hours by Occupation for Two Months at Smithland

	March 1973			May 1973		
Occupation	Actual	Predicted	Percent Difference Between Predicted and Actual	Actual	Predicted	Percent Difference Between Predicted and Actual
Carpenters	8,405	9,951	+ 18%	9,463	10,531	+ 11%
Teamsters	1,688	1,520	- 10	1,637	1,609	- 2
Laborers	11,408	11,980	+ 5	10,901	12,675	+ 16
Operating Engineers	2,637	2,921	+ 11	2,509	3,091	+ 23
Mechanics	1,412	1,590	+ 13	1,384	1,683	+ 22
Oilers and Greasers	1,197	1,300	+ 8	1,315	1,377	+ 5
Total	30,988	32,962	+ 6	31,696	33,286	+ 5

than "in the ball park," It is also significant that even the occupations with relatively small numbers of man-hours (i.e., teamsters, mechanics, and oilers and greasers) are accurately predicted by the coefficients although larger error would be expected when small values are involved.

It seems clear that Corps of Engineers projects are well suited for inclusion in an Early Warning System. Dollar outlays can be easily projected, and the manpower experience of prior similar projects appear to form a solid basis for the manpower requirements of later projects. Once the complete payrolls of several or each type of Corps procurement were analyzed and the appropriate manpower coefficient for each type and work phase determined, projections for any particular award could be made in a matter of a few days. Semi-annual updating, a matter of a day's work, would insure the accuracy of the projections.

Projected Demand for Operating Engineers in Kentucky

The Smithland lock and dam project is only one of a large number of Federal construction projects in the region. The Corps of Engineers alone is expected to spend $57.5 million in Kentucky in fiscal year 1975. Much of the hiring for these major construction projects takes place through the union hiring halls of the various crafts. The Laborers International Union and the International Union of Operating Engineers were contacted to determine their interest in training programs as these were the two skills projected to show the largest needs at Smithland. The Operating Engineers Union felt that the projected increase at Smithland alone would not warrant a special training program. They were, however, concerned about the fact that many of their members had inadequate skills and were finding it difficult to obtain steady employment. They were therefore interested in a program designed to upgrade the work skills of underemployed local members.

The conference/workshop, therefore, addressed the problem of upgrading training for operating engineers not only at the Smithland site but for all projects in their jurisdiction.

Projected Demand for Operating Engineers. Three steps were involved in projecting demand for operating engineers over the next 12 months: 1) the total construction workforce was estimated; 2) the proportion of the construction workforce consisting of operating engineers was ascertained; and, 3) deaths and retirements from the workforce were allowed for.

Estimated total civilian employment in the construction industry in Kentucky was based on NPA's regional economic projections[1] as follows:

	1974	1975
Civilian Employment in Construction Industry	70,700	72,200

The proportion of this workforce consisting of operating engineers was estimated at 10 percent based on detailed occupation by industry data provided by the Kentucky Bureau of Employment Security from the 1970 census. Allowing for deaths and retirements at 1.5 percent annually based on the rates for the corresponding occupations published in Tomorrow's Manpower

---

[1] National Planning Association, Regional Economic Projections: 1960-85, Report 73-2-1, 1973.

Needs, the total demand and increase in job openings is as shown in the following table.

Table 7

Estimated Job Openings for Operating Engineers in Kentucky, 1975

	Estimated Employment		Employment Growth	Deaths and	Total Job
	1974	1975	1974-75	Retirements	Openings
Operating Engineers	7,070	7,220	150	110	260

The NPA projections show continued growth in employment in the construction industry, indicating that approximately 260 job openings can be expected annually over the next few years.

Relating the Demand Projections to Underemployment Among Operating Engineers. Data on employment of operating engineers comes from union records for Local 181 which has jurisdiction in Kentucky. The pension fund records of the union show that 6,302 union members worked in Local 181's jurisdiction during calendar year 1973, of which approximately 2,000 were members of other locals working under temporary work permits. The remaining 4,500 or so were members of Local 181. Table 8 shows the Local 181 members and their full-time equivalent weeks of work on union construction jobs during 1973.

Table 8

Local 181 Members by Full-Time Equivalent Weeks of Union Construction Work in Calendar Year 1973

Full-Time Equivalent Weeks of Union Construction Work	Number of Members
No work reported	909
Less than 10 weeks	350
10 but less than 20 weeks	391
20 but less than 30 weeks	606
30 but less than 40 weeks	821
40 but less than 50 weeks	787
50 weeks and over	627
Total	4491

The 391 who worked between ten and twenty weeks were selected for intensive review to determine if union employment records could provide the necessary information to identify likely candidates for upgrading training. The union records contained detailed information for 340 union members in this group. Table 9 shows that of these Local 181 members,

Table 9

Local 181 Members Employed in Union Construction Jobs The Equivalent of Ten to Twenty Weeks During 1973, by Skill Level

Skill Level	Workers Under 50 Years of Age	Workers Over 50 Years of Age
Already at high skill level	68	40
Candidates for upgrading	152	80
Misc. light equip. operators	73	34
Oilers/greasers	15	2
Mechanics	4	4
Heavy equip. operators (low skill or operating only one machine)	60	40
Total	220	120

there were 152 under the age of fifty and 80 fifty years of age or older who were at low skill levels and could benefit from upgrading training. The remainder already appeared to be at high skill levels, since they could operate two or more pieces of heavy equipment.

If the proportion of workers at the lower skill levels in the sample group were applied to all members of Local 181 who worked ten to thirty weeks on union construction jobs during the year, there would be approximately 450 members under the age of fifty and 235 fifty years or over who could improve their employability by upgrading their skills. Many additional union members might benefit from such training, such as those working less than ten weeks during the year.

The average number of annual hours worked on union construction sites in 1973 was 1,200 per member, according to Local 181 records. At this rate, the 260 additional workers needed in 1975 from growth and replacement derived in Table 7 represent 312,000 hours of work. These hours are over-and-above the number of hours available in 1974. Therefore, it would be possible to upgrade several hundred underemployed operating engineers (those who are currently working below the 1200-hour average) without reducing the employment opportunities for those who worked full-time (1,200 hours or more).

The average hours worked on union construction sites during 1973 by underemployed 181 members was 500. If upgrading training were to result in an increase in hours worked from the 500-hour level to the 1,200-hour union-wide average (an increase of 700 hours per trainee), then 445 trainees could be accommodated without affecting the number of hours of work available to non-trainees, as shown below:

$$\frac{\text{Total Additional Hours Available (312,000)}}{\text{Average Increase in Hours Worked per Trainee (700)}} = \text{Number of Individuals Who Can be Trained Without Affecting Non-Trainees' Hours (445)}$$

The linking of the available data on underemployment among operating engineers and the projections of future demand indicate that a successful upgrading training effort could be launched over the next year or so.

II. The Rocketdyne SSME Project

Introduction. The Space Shuttle Main Engine (SSME) contract with the Rocketdyne Division of Rockwell International is part of the major space venture for the nation for the seventies. The goal of the NASA project is to develop a reusable space shuttle. The total cost of the shuttle program is estimated at 5.4 billion. The SSME contract is for an estimated $550 million, or about 10 percent of the total.

There are two major work phases on the SSME. The first is the design stage. This stage began in late 1971 and is expected to be completed at the end of the 1975 calendar year. From 1976 to 1979 Rocketdyne will go into actual production of the engines for the shuttle.

The Rocketdyne plant is located in Canoga Park, California, in the Los Angeles/Long Beach area.

Data and Data Sources. Data were collected from several offices within NASA, from company officials, from the firm's Affirmative Action Plan obtained through the Office of Federal Contract Compliance of the Department of Labor, and from various Commerce Department publications related to industry statistics. This section details the data collected and their sources:

1. NASA Division of Resource Analysis. The Division of Resource Analysis, located in Washington, D.C., attempts to assess the overall manpower impact of NASA procurement programs. The Division has data on the historical cost per man-year for the contracting firm and for

all firms producing similar products (i.e., all launch vehicle contracts). Additionally, the Division has projected outlays for the SSME by fiscal year through completion.

2. NASA Shuttle Program Office. The Shuttle Program Office in Washington, D.C. has overall control over budgeting of the Shuttle Program and the SSME. At the time the Federal budget is released (in January of each year) the Program Office can provide an estimate of the appropriation for the SSME for the upcoming fiscal year. The Office also has data on the previous years' appropriations and direct equivalent man-years for the project, the amount of "in-house" expenditures (total expenditures less subcontracts, materials, and supplies), the recipients of subcontracts, and other pertinent facts.

3. NASA Marshall Space Flight Center. The Marshall Space Flight Center in Huntsville, Alabama also has an office which is monitoring the SSME contract. Staff at the Center have prepared "manning curves" which show the number of workers needed by department (engineering, testing, manufacturing, etc.) over the life of the project. In conjunction with these curves are key milestones during the development process. These milestones often signal changes in the manpower requirements. Officials at the Center also made available to NPA data from the firm on the numbers of workers in each department needed not only on the SSME, but on all ongoing projects at Rocketdyne in FY 1973, 1974 and 1975. Figure 7 (following this page) shows manning curves for several occupational groups and the key milestones of the development process.

32A

BEST COPY AVAILABLE

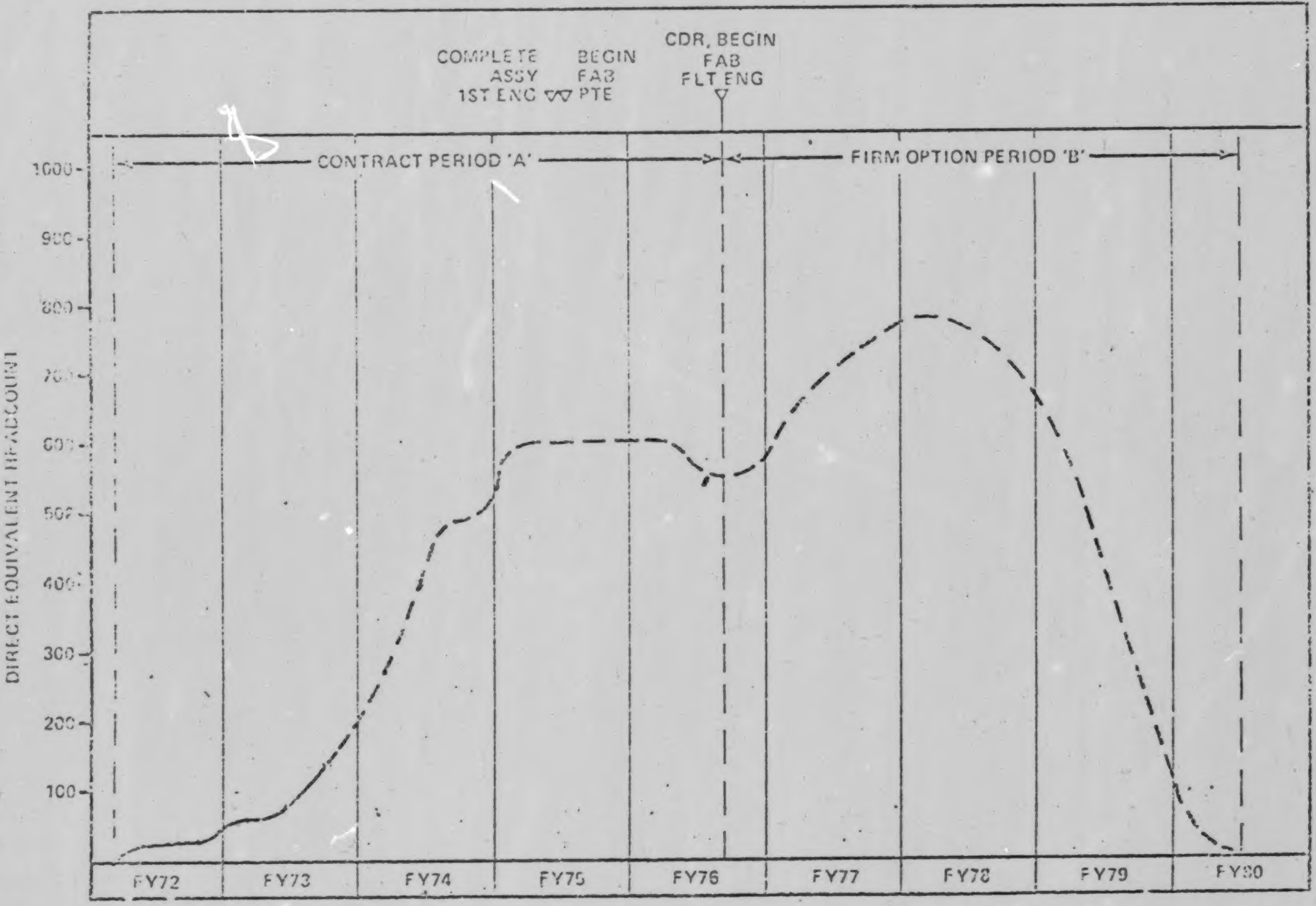
[illegible] PROJECTS OFFICE
SPACE SHUTTLE MAIN ENGINE

MARSHALL SPACE FLIGHT CENTER

MANUFACTURING MANPOWER

NAME
W.D. BROWN

DATE
4-5-73



SSME-262

Figure 7

32B

BEST COPY AVAILABLE

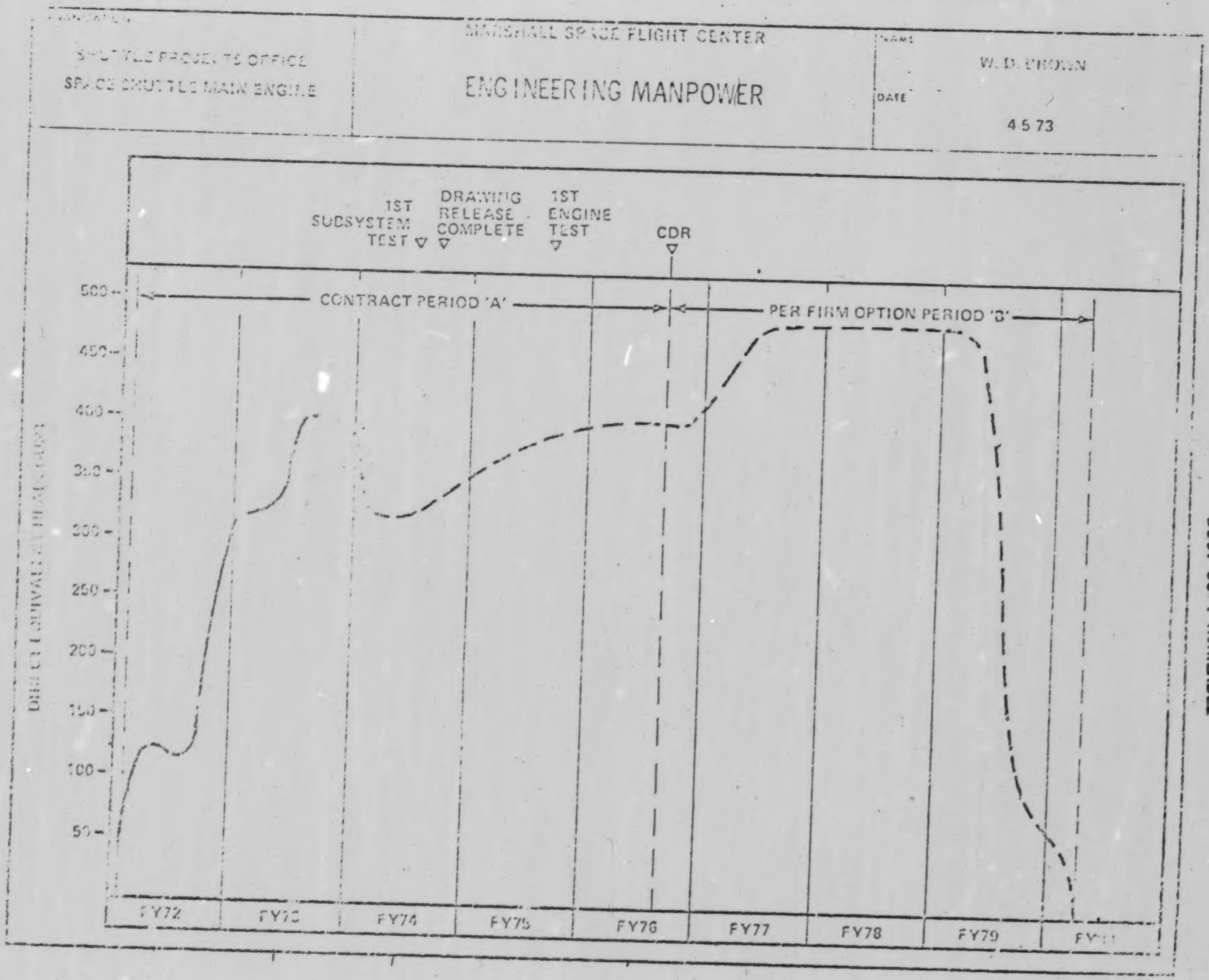


Figure 7 (cont'd)

4. Rocketdyne. Rocketdyne officials were able to provide some data on manpower needs to NPA. This included total manpower needs through FY 1975 and the manufacturing manpower on the SSME broken down by the major crafts involved through FY 1976.

5. Department of Labor. The Office of Federal Contract Compliance supplied the Rocketdyne 1972 Affirmative Action Plan, which provides occupational data by major occupational groups and supplementary data on individual job actions (hires, quits, deaths, retirements, discharges, and promotions) for a nine-month period at the plant.

6. Department of Commerce. Unpublished 1970 Census data on occupational employment by industry for the state of California were obtained. This provided a detailed occupational break-down of the aircraft industry for the state (SIC 372), which is heavily aerospace in character. Also collected were aerospace and NASA contract oriented data on employment, value added, and value of shipments on a detailed industry or geographic basis. These included: (a) five-digit detail for R & D in Missiles and Space Vehicle Propulsion Units (SIC 37225); (b) three-digit detail on the Aircraft and Parts Industry (SIC 372) in the Los Angeles/Long Beach SMSA from the 1967 Census of Manufacturers;1/ and (c) four-digit detail for contractors in the Aircraft Engine and Parts Industry (SIC 3722) shipping to NASA from "Shipments of Defense Oriented Industries: 1970."2/

1/ U.S. Department of Commerce, Bureau of the Census, Census of Manufacturers, 1967, Industry Series: Aircraft and Parts, MC67(2)-37B, 1970, p.22.

U.S. Department of Commerce, Bureau of the Census, Census of Manufacturers, 1967, Area Series: California, MC67(3)-5, 1970, p.20.

2/ U.S. Department of Commerce, Bureau of the Census, Current Industrial Reports Series, MA-175(70)-1, "Shipments of Defense Oriented Industries: 1970," 1972, pp.12,13.

Projection Procedures. The specific steps involved in the projection procedures for Rocketdyne are summarized below:

1. Determining the total and "in-house" dollars for the SSME to be spent in each fiscal year;
2. Determining the relationship between the "in-house" dollars and total manpower (employment per $1 million of expenditures), and applying the coefficient to the projected "in-house" dollars from #1 to obtain total SSME employment;
3. Adding the expected employment from other projects at Rocketdyne to the SSME employment figure;
4. Determining the occupational distribution for the SSME and other projects and applying the distribution to the projected total employment from #3;
5. Adjusting occupational figures from #4 for deaths, retirements and discharges.

1. Determining the total and "in-house" dollars for the SSME by fiscal year:

In July 1973 the Division of Resource Analysis provided NPA with projected appropriations for the SSME. In October, NPA obtained the actual 1973 and anticipated 1974 fiscal year figures from the Shuttle Program Office. These data are presented in Table 10. It can be seen that the 1973 and anticipated 1974 outlays are below those originally projected. It is uncertain whether this will result in a speed-up of appropriations beginning in FY 1975 in order to "catch up" or whether the short-fall will be made up at the end of the project. Budgeting decisions are the domain of Congress, and until a new estimate

Table 10

Initial Projection of Annual Budget Outlays for SSME by Fiscal Year
1973 Actual and 1974 Anticipated Outlays
(millions of dollars)

	1972	1973	1974	1975	1976	1977	1978	1979	To Completion	Total
Initial Budget Outlay Projections (1)	$ 5.1	$48.9	$78.0	$73.8	$89.2	$106.7	$88.4	$49.7	$12.6	$552.4
Actual Outlays (2)		$42.8								
Anticipated Outlays (2)			$64.1							

---

(1) NASA, Division of Resource Analysis and Shuttle Program Office

(2) NASA, Shuttle Program Office.

is available from the President's Budget in January 1974 we have assumed that spending for the SSME will return to the original projected level of $73.8 million.

2. Determining the relationship between the dollars and total manpower:

Several factors had to be considered in constructing an employment per $1 million of outlays. First, what was the relationship in the past years on the SSME? Was this relationship likely to change? How was the relationship affected by subcontracting of work? It was found that the degree of subcontracting could vary from one year to the next and that this caused the man-years per $1 million of total cost to vary substantially. Consequently, the coefficient was based on man-years per $1 million of "in-house" cost. In-house cost is similar to the "value added" concept used by the Department of Commerce in its Census of Manufacturers. In-house expenditures exclude outlays for subcontracts, services, materials and supplies.

Manpower on NASA contracts is divided into two categories, "direct" workers, generally referred to as "direct equivalent head count", and "overhead" workers. The first category includes all workers directly involved in design, manufacturing, testing and other production activities, while the latter includes administrative, managerial and other support personnel. This distinction is similar to that found in the Electric Boat investigation, where manpower was divided between direct "productive" labor and indirect "overhead" workers. Officials at the Shuttle Program Office said the overhead rate at Rocketdyne was about 100 percent of the direct equivalent head count (DEH) in fiscal year 1973, but that for ongoing projects the rate was closer to 75 percent. It was brought out that the level of overhead employment was likely to be greater during the beginning stages of a project, when production employment is just beginning to rise, than when the project is fully underway.

Overhead employment at the plant could be derived based on data supplied by the company and the discussions with Shuttle Program Office officials. The process is shown in Table 11. Given the total plant work force of 3,144 and the direct work force of 1,705, overhead employment is the difference, or 1,439. Then, given that overhead employment associated with the SSME was 100 percent of the direct project manpower, or 598, the difference between total overhead already derived (1,439) and SSME overhead (598) is the overhead employment on other projects, or 841. Overhead employment as a percent of direct employment for "other" projects can then be calculated at 76 percent. This derived percentage is close to the overhead rate of 75 percent which NASA officials indicated as normal for ongoing projects.

It can be expected that the overhead work force on the SSME will, over the course of a few years, decline relative to the direct manpower to conform to the ratio of other projects at the plant. The overhead rate for the SSME was therefore set at 86 percent for FY 1974 and the plant rate for ongoing projects, 76 percent, for 1975.

With the overhead rates, the employment per $1 million of outlays, and the total and "in-house" dollar projections, total employment on the SSME can be projected. Mid-year 1974 figures from the Shuttle Program Office called for 906 man-years of effort, total outlays of $64.1 million, and materials and subcontracts totalling $20.6 million.

Table 11

Derivation of Estimated Overhead Employment Rocketdyne and Overhead Employment as a Percent of Direct, Fiscal Year 1973

Given From Company and NASA Data:	
Total Employment at Rocketdyne (Direct and Overhead)	3,144
Direct Equivalent Head Count	1,705
SSME	598
Other Projects	1,107
Derived from Company and NASA Data:	
Total Overhead Employment (Total employment less direct equivalent)	1,439
Overhead Employment:	
SSME:	
SSME Overhead as a Percent of Direct (Given by NASA officials)	100%
SSME Overhead Employment	598
Other Projects:	
Overhead Employment for Other Projects (Total overhead less SSME overhead)	841
Overhead Employment on Other Projects as a Percent of Direct	76%

Thus, the expected DEH per million dollars of "in-house" cost is 21, slightly lower than the 22 in 1973. This decline probably reflects a productivity increase during the year. The 21 direct man-years figure was used to estimate the 1975 DEH for the SSME. Table 12 shows the steps involved. For 1975, in-house outlays are estimated at 151.7 million, or 70 percent of total outlays. This is in keeping with the upward "trend" (in-house outlays were 63 percent of the total in 1973 and are estimated at 68 percent in 1974); moreover, as the project moves closer to "production" more dollars can be expected to be spent in-house. The overhead rate for the SSME is projected at 86 percent of the DEH in 1974 and 76 percent in 1975. Table 12 shows the historical 1973, the estimated 1974 and the projected 1975 figures for employment and expenditures.

Table 12

Employment and Employment Per Million Dollars of Expenditures on SSME, FY 1973, 1974, 1975

	FY 1973	FY 1974	FY 1975
SSME Expenditures: (in millions)			
Total Outlays	$42.8(1)	$64.1(1)	$73.8(3)
Amount of Materials, Supplies, Services, Subcontracts	15.8(1)	20.6(1)	22.1(2)
"In-house" Outlays	27.0	43.5	51.7
SSME Direct Manpower: (in man-years)	598(1)	906(1)	1,085(2)
SSME Direct Manpower Per Million Dollars of "In-house" Outlays:	22	21	21
SSME Overhead Manpower as a Percent of Direct Manpower	100%(1)	86%(2)	76%(2)
SSME Overhead Manpower (in man-years)	598	779	825
SSME Total Manpower	1,196	1,685	1,910

---

(1) Data from NASA Shuttle Program Office.

(2) Estimated from NASA data. See Table 10 and preceding discussion.

(3) Data from NASA Division of Resource Analysis.

3. Estimating employment on other projects at Rocketdyne:

Employment on the SSME will not account for all of the employment at Rocketdyne over the next few years. There are about ten projects other than the SSME currently underway at the plant, and most of them are expected to continue at about the same level. It is necessary to project future manpower needs for these other projects as well as for the SSME because of the possibility of workers shifting from declining projects to the SSME, or the possibility of increased employment requirements for the other projects which would increase the total number of workers needed at the plant.

Company data provided to NASA gave the expected direct equivalent head count for these other projects. To derive total employment on these projects, the DEH must be adjusted for the inclusion of overhead workers. The overhead rate for ongoing projects was derived in the prior section at 76 percent of the DEH. This 76 percent rate can be applied to the future anticipated direct employment on other projects to obtain total employment. Table 13 shows the estimated employment on other Rocketdyne projects.

Table 13

Estimated Employment on Other Projects
at Rocketdyne, FY 1973, 1974, 1975

	FY 1973	FY 1974	FY 1975
Direct Equivalent Headcount (in man-years)	1,107	1,038	1,094
Overhead Employment as a Percent of Direct	76%	76%	76%
Overhead Employment (in man-years)	841	789	831
Total Employment (in man-years)	1,948	1,827	1,925

4. Determining the occupational distribution for the SSME and other projects and applying the distribution to the projected employment from #2 and #3.

No single source was able to provide all of the detailed occupational information needed. Consequently, data from several sources had to be combined to derive a plant occupational profile. The data available were: (a) actual employment by broad occupational groups (i.e., professional and technical, craftsmen and operatives, etc.) in October 1972 and the expected employment in October 1973 from the Rocketdyne Affirmative Action Plan; (b) data provided by the company on the various skills needed in the manufacturing component for the SSME; and (c) data from the 1970 Census of Population on the distribution of employment by detailed occupation for the Aircraft and Parts industry (SIC 372) for the state of California.

These data were used in what may be described as an "iterative" process, involving the following steps: (1) projecting the distribution of the broad occupational groups to 1974 and 1975 based on the historical trend, the expected changes in work character, and the industry data; (2) using the company data on occupations needed in the manufacturing component of production and inserting these numbers as "fixed cells" in the detailed occupational breakdown; and (3) utilizing the California census data to fill in detailed occupations not available from company and NASA data.

(1) Projecting the distribution of broad occupational groups. First the occupational distribution in the Rocketdyne Affirmative Action Plan was examined. The actual October 1972 and anticipated October

1973 figures are shown in Table 14. These percentages can be compared with the occupational distribution from the 1970 Census of Population for the state of California for SIC 372 (Aircraft and Parts). It can be seen that there is considerable divergence between the Rocketdyne professional and technical and craftsmen and operatives distributions and the census percentages. This is likely due to two main factors. First, while the census data for California is heavily weighted by aerospace type employment, some of the employment is in conventional aircraft production which could be expected to use more production workers, such as craftsmen and operatives, because the production process is fully developed and mechanized. Also, perhaps one quarter of Rocketdyne's employment in 1972 was on the design of the SSME, which would require proportionally more professional and technical workers than craftsmen or operatives. As parts and components begin to be manufactured for testing purposes in 1973, the expected proportion of craftsmen and operatives

Table 14

Distribution of Employment at Rocketdyne, October 1972 and Anticipated October 1973, by Broad Occupational Groups, Compared with 1970 Aircraft Industry for California

Occupational Group	Rocketdyne Actual October 1972	Rocketdyne Anticipated October 1973	1970 California Census for SIC 372
Professional & Technical	49.1%	45.5%	28.9%
Officials, Managers & Sales	9.6	8.8	6.4
Craftsmen & Operatives	21.8	27.3	44.7
Office & Clerical	16.2	15.3	17.8
Laborers & Service Workers	3.3	3.1	2.2
Total	100.0%	100.0%	100.0%

rises from 22 percent to 27 percent, while the professional and technical occupations decline from 49 percent to 45 percent.

As employment on the SSME moves from testing toward production, employment of professionals can be expected to make up a decreasing proportion of the Rocketdyne work force, with the decrease picked up by the craftsmen and operatives. However, even at full production, the percentages should be somewhat different than the industry-wide data because of the differences in the products produced (rocket engines rather than all types of aircraft). With this information in mind, the 1974 and 1975 distributions for the broad occupational groups were estimated by moving the Rocketdyne distribution for professional and technical and craftsmen and operatives toward the industry-wide percentages. This procedure approximates the movement of the SSME work effort out of design and toward manufacturing over the next few years. These distributions are shown in Table 15 (below). The distribution shown for 1973 in Table 15 differs slightly from that in Table 14 because the Table 15 figures reflect the average distribution for the

Table 15

Projected Distribution of Broad Occupational Groups
at Rocketdyne, Fiscal Years 1973, 1974, 1975

	1973	1974	1975
Professional & Technical	46.5%	41.0%	36.0%
Officials, Managers & Sales	9.0	9.0	9.0
Craftsmen & Operatives	26.0	31.5	36.5
Office & Clerical	15.5	15.5	15.5
Laborers & Service Workers	3.0	3.0	3.0
Total	100.0%	100.0%	100.0%

fiscal year rather than the distribution at a point in time, as do the figures in Table 14.

(2) Using company data on the skills required in the manufacturing component of production and inserting them as "fixed cells". The number of workers needed in manufacturing on the SSME and other projects was derived from company data supplied to NPA and from company data supplied to NASA. Adjustments were made so that the data would conform to the U.S. fiscal year (the company fiscal year runs from October to October). Table 16 shows this information. First the proportion of direct manpower accounted for by the manufacturing group was ascertained from the company data. This was applied to the estimates of

Table 16

Deriving the Manufacturing Manpower Estimates for the SSME and Other Rocketdyne Projects, FY 1973, 1974, 1975

	1973	1974	1975
SSME			
Manufacturing Manpower as a Percentage of Direct Manpower (1)	18.6%	38.1%	38.6%
Projected Direct Manpower (2)	598	906	1,085
Derived Manufacturing Manpower	111	345	418
OTHER PROJECTS			
Manufacturing Manpower as a Percentage of Direct Manpower (1)	34.4%	33.5%	26.3%
Projected Direct Manpower (3)	1,107	1,038	1,094
Derived Manufacturing Manpower	381	348	288

---

(1) Derived from company data.

(2) See Table 12 for source of estimate.

(3) See Table 13 for source of estimate.

direct manpower derived previously to obtain total manufacturing manpower requirements. The rising percentage of manufacturing workers on the SSME is reflective of the project completing certain design requirements and initiating manufacturing and testing, while the decline in manufacturing in other ongoing projects reflects the completion of production, with more workers needed in the areas of logistics and launch support.

Next, the manufacturing total was distributed to individual occupations on the basis of occupational data for the group provided to NPA by the firm. This data pertained only to the distribution of skills by fiscal year through 1976 for the SSME. We used the 1976 SSME distribution to determine the manufacturing manpower on all ongoing Rocketdyne projects, as this distribution was judged to be most reflective of such projects because it represented a "full production" work phase. Table 17 shows the derivation of the occupational estimates for the manufacturing component based on applying the distribution of occupations obtained from the company to the estimated manufacturing manpower totals.

The occupational figures obtained for manufacturing manpower were then inserted into the occupational profile as "fixed cells," i.e., they were taken as "given" when calculating other occupations within the craftsmen and operatives group.

Table 17

Derivation of Occupational Estimates for Manufacturing Manpower at Rocketdyne, FY 1973, 1974, 1975

	1973		1974		1975	
	% Distribution	Number	% Distribution	Number	% Distribution	Number
SSME MANUFACTURING MANPOWER	100.0%	111	100.0%	345	100.0%	418
Tool Makers	39.5	44	28.4	98	13.9	58
Machinists (including machine operators)	19.7	22	29.2	101	31.6	132
Welders	2.6	3	9.2	31	10.5	44
Sheet Metal Fabricators	1.3	1	12.9	45	18.8	79
Precision Assemblers	0.0	0	1.5	5	9.0	38
OTHER ONGOING PROJECTS MANUFACTURING MANPOWER	100.0%	381	100.0%	348	100.0%	288
Tool Makers	10.7	41	10.7	37	10.7	31
Machinists (including machine operators)	32.8	125	32.8	114	32.8	94
Welders	11.9	45	11.9	41	11.9	34
Sheet Metal Fabricators	17.5	67	17.5	61	17.5	50
Precision Assemblers	11.3	43	11.3	39	11.3	32
TOTAL MANFACTURING MANPOWER AT ROCKETDYNE	N.A.	492	N.A.	693	N.A.	706
Tool Makers	N.A.	85	N.A.	135	N.A.	89
Machinists (including machine operators)	N.A.	147	N.A.	215	N.A.	226
Welders	N.A.	48	N.A.	72	N.A.	78
Sheet Metal Fabricators	N.A.	68	N.A.	106	N.A.	129
Precision	N.A.	43	N.A.	44	N.A.	70

N.A. - Not Applicable

(3) Utilizing the California census data to fill in the remaining occupational details. Figures for the remaining occupations were obtained by applying the distribution of workers within the census broad occupational groupings to the numbers projected for those groups for Rocketdyne. For example, in the professional and technical category, scientists and engineers, according to the census data, account for 57 percent of total employment (16.5 percent of total employment are scientists and engineers, while 28.9 percent of total employment are professional and technical: 16.5 ÷ 28.9 = 57 percent). This percentage is then applied to the projected total employment expected to be professional and technical in 1973, 1974 and 1975. Thus, when in 1973 1,462 workers are expected to be professional and technical, 833 are expected to be scientists and engineers (1,462 x .57). By 1975, when only 1,380 of the total work force is expected to be in the professional and technical category, scientists and engineers are projected to decline proportionally to 786 workers. In the craftsmen and operative category, where manufacturing manpower were inserted as fixed cells, this amount was deducted from the total projected for the category and the remainder allocated to the census occupations according to their representation in the census data.

The three steps discussed above and the resulting occupational employment are shown in Table 18.

This procedure, although it appears cumbersome and complex, has many advantages over the straight application of a standard industry-occupational distribution. The procedure used allowed for as much data input directly related to the firm's past and projected experience as was available, and then supplemented this with data from industry

Table 18

Deriving Detailed Occupational Estimates at Rocketdyne, FY 1973, 1974, 1975

	Broad Occupational Groups			Fixed Cells			Distribution of Census Occupational Details Within Broad Group Figures and Fixed Cells			Employment by Occupation		
	1973	1974	1975	1973	1974	1975	1973	1974	1975	1973	1974	1975
Total Rocketdyne	3,144	3,512	3,832							3,144	3,512	3,832
Professional, Technical and Kindred	1,462	1,440	1,380				(100.0%)	(100.0%)	(100.0%)	1,462	1,440	1,380
Scientists and Engineers							57.0	57.0	57.0	833	822	786
Other Professional							26.5	26.5	26.5	387	379	364
Technical							12.0	12.0	12.0	176	172	165
Draftsmen							4.5	4.5	4.5	66	67	65
Managerial and Sales	283	316	345							283	316	345
Craftsmen, Operatives and Kindred	818	1,106	1,399				(100.0%)	(100.0%)	(100.0%)	818	1,106	1,399
Tool Makers				85	135	89				85	135	89
Machinists				147	215	226				147	215	226
Welders				48	72	78				48	72	78
Sheet Metal Fab. and Misc.				68	106	129				68	106	129
Precision Assemblers				43	44	70				43	44	70
Other Assemblers							20.4	21.4	19.4	87	114	157
Foremen							15.9	15.7	16.1	68	84	130
Checkers and Examiners							12.9	12.7	13.0	55	68	105
Engine Mechanics and Repairmen							18.3	18.0	18.5	78	96	149
Electricians							3.5	3.4	3.5	15	18	28
Pattern and Model Makers							2.8	2.6	2.7	12	14	22
Other							26.2	26.2	26.8	112	140	216
Clerical Workers	487	545	593				(100.0%)	(100.0%)	(100.0%)	487	545	593
Secretaries, Steno and Typists							32.9	32.9	32.9	160	179	195
Clerks							29.0	29.0	29.0	141	158	172
Office Machine Operators							7.8	7.8	7.8	38	43	46
Others							30.3	30.3	30.3	148	165	180
Service Workers and Laborers	94	105	115							94	105	115

sources. The data used were not only "firm specific", but in large part "project specific". These positive factors understandably outweigh any disadvantages associated with the procedure's complexities. Significantly different results would have been obtained had the industry pattern of occupations from California been directly applied to the projected total employment.[1/] While the Aircraft industry (SIC 372) in California is substantially aerospace, it also contains a conventional aircraft component. This probably accounts for part of the difference between the distribution of occupations of the two. Another factor is that the industry data represent the sum of all firms in the industry, each with a variety of projects in different work phases. As was shown in Table 13, manufacturing manpower as a percentage of total direct employment can vary substantially, depending on the work being performed. Similar variations exist in other occupational groups (e.g., professional and technical). Figures from industry sources on the distribution of employment may differ from the figures of an individual firm in that industry simply because the work phases of the firm's projects do not coincide with those of the industry as a whole.

5. Adjusting the occupational projections for deaths, retirements, discharges and promotions:

Once the total "job count" for each occupation has been determined, the data should be adjusted to reflect what might be considered normal increases in job vacancies resulting from deaths, retirements, and the like. Quits should not be included because of the uncertainty of an appropriate rate. The rate of quits is dependent upon such factors as the economic well-being of the firm, the industry, and other industries utilizing the particular skill needed.

[1/] This comparison is made in the final portion of this section.

Data from the Rocketdyne Affirmative Action Plan (AAP) allowed these adjustments to be made. The AAP contained figures on individual separations at the plant for a ten-month period (January - October 1972) by reason (i.e., death, retirement, quit, lay-off, discharge). Ignoring lay-offs, which are picked up by the occupational projections themselves, and quits, for the reasons given above, the remaining separations were grouped by occupation.

Total separations due to deaths, retirements, and discharges amounted to almost 2.2 percent of the work force at the end of the January - October 1972 period. Future deaths, retirements, and discharges were also projected at the 2.2 percent figure. These separations were then distributed to individual occupations based on the occupational distribution of the separations in the base period (January - October 1972). This procedure is in contrast to the one used in the other two contracts, where deaths, retirements and discharges were assumed to be equal among all occupational groups; however, in the cases of Smithland and Pullman, either specific occupational data were not available, or the data indicated no differences among the occupational groups. Comparison of the distribution of employment by occupation and the distribution of separations by occupation for October 1972 at Rocketdyne reveals that while laborers and service workers accounted for only 3 percent of employment they accounted for 22 percent of all separations. Professional and technical workers accounted for 49 percent of employment but only 22 percent of the separations.

A large number of discharges in the laborer and service worker category is probably the result of the difficulty in finding and keeping workers who are willing and able to do the type of work desired at the wages offered. Moreover, workers tend to be promoted to managerial levels late in their careers (and are therefore more likely to die or retire in that position), and this may explain why managerial and sales workers accounted for 10 percent of the employment but 20 percent of the separations. These differences are ample reason to apply the past experience regarding separations rather than assume a distribution identical to the employment patterns for the period. Table 19 shows the historical data on deaths, retirements and discharges which were incorporated into the projections.

Table 19

Deaths, Retirements and Discharges at Rocketdyne by Occupation
January - October Period, 1972

Deaths, Retirements and Discharges as a Percentage of the End-of-Period Work Force	2.17%
Occupational Distribution:	100.0%
Professional and Technical	21.5
Scientists and Engineers	7.7
Other Professional	6.1
Technical and Draftsmen	7.7
Managerial and Sales	20.0
Craftsmen and Operatives	24.6
Tool Makers	-
Machinists	4.6
Welders	-
Sheet Metal Workers	-
Precision Assemblers	1.6
Other Assemblers	1.6
Other	16.9
Clerical Workers	12.3
Secretaries, Steno., Typists	4.6
Clerks	1.5
Other	6.2
Service Workers and Laborers	21.6

A further adjustment which would be desirable would be to take account of the promotional practices of the firm. For example, a vacancy in a managerial position may be filled not by hiring a new one from the outside but by promoting a engineer or scientist to the position. This, of course, creates a new vacancy at the professional and technical level. This type of upward mobility ladder is present at Rocketdyne; however, specific adjustment could not be made because of insufficient data. In interpreting the projections, it should be remembered that any increase shown in the higher skilled jobs may be slightly overstated (because some of the jobs will be filled through promotions up the ladder) and that increases in the lower skill jobs may be correspondingly understated (because of promotions out of the occupation).

Table 20 shows the results of adjusting the total employment figures from Table 15 for deaths, retirements, and discharges. An increase in the overall job count will result in the need to hire 320 new workers. Deaths, retirements and discharges for the year will push this total above 400 on an annual average basis. These figures include the laying-off of 42 professional and technical workers and 46 tool makers. Total hires for the year will therefore approach 500. As the SSME moves out of design and toward production, the increases are expected to be concentrated in the craftsmen and operatives areas, with higher level professionals showing a slight decline.

Projected Employment at Rocketdyne and Employment Adjusted for Deaths, Retirements and Discharges, FY 1973, 1974, 1975

	Total Employment			Projected Deaths, Retirements, Discharges		Net Hires	
	1973	1974	1975	1973-74	1974-75	1973-74	1974-75
Total Rocketdyne	3,144	3,512	3,832	+ 77	+ 83	+ 445	+ 403
Professional, Technical and Kindred	1,462	1,440	1,380	17	18	- 5	- 42
Scientists and Engineers	833	822	786	6	6	- 5	- 30
Other Professional	387	379	364	5	5	- 3	- 10
Technical	176	172	165	4	5	0	- 2
Draftsmen	66	67	65	2	2	+ 3	0
Managerial and Sales	283	316	345	15	17	+ 48	+ 46
Craftsmen and Operatives	818	1,106	1,399	19	21	+ 307	+ 314
Tool Makers	85	135	89			+ 50	- 46
Machinists	147	215	226	4	4	+ 72	+ 15
Welders	48	72	78			+ 24	+ 6
Sheet Metal Fab. and Misc.	68	106	129			+ 38	+ 23
Precision Assemblers	43	44	70	1	1	+ 2	+ 27
Other Assemblers	87	114	157	1	1	+ 28	+ 44
Foremen	68	84	130	3	3	+ 19	+ 49
Checkers and Examiners	55	68	105	2	2	+ 15	+ 39
Mechanics and Repairmen	78	96	149	4	4	+ 22	+ 57
Electricians	15	18	28	0	1	3	11
Pattern and Model Makers	12	14	22	0	0	2	8
Others[1/]	112	140	216	4	5	+ 32	+ 81
Clerical Workers	487	545	593	10	10	+ 68	+ 58
Secretaries, Steno., Typists	160	179	195	4	4	+ 23	+ 20
Clerks	141	158	172	1	1	+ 18	+ 14
Office Machine Operators	38	43	46	1	1	+ 6	+ 4
Others	148	165	180	4	4	+ 21	+ 19
Service Workers and Laborers	94	105	115	16	18	+ 27	+ 28

[1/] Includes all craftsmen and operatives occupations accounting for less than one half of 1 percent of total employment.

Revising and Updating the Projections. Revisions in the projections may be needed for a variety of reasons. Congressional appropriations may not be the same as the amount requested by the President in his annual budget. Upward revisions in the total project cost is also not uncommon in R & D contracts. Projections based on the annual lifetime project expenditures from the Division of Resource Analysis actually reflect an anticipated plan of attack which will be subject to modification because of other budgetary priorities. This does not mean that accurate projections cannot be made. The Shuttle Program Office closely monitors the SSME contract. The Office can provide accurate estimates of direct man-years for the ongoing fiscal year. Once the President's budget message is released in January of each year the Office can provide the expected level of funding for the upcoming year beginning in July. After Congress makes its final appropriation a further revision may be warranted if there is a significant difference between the President's budget request and the appropriation. There is ample time to revise the total employment estimate by applying the manpower coefficients to the new dollar figure.

A second area where revisions may be necessary is in the distribution of occupations. Here the data on milestones provided by the Marshall Space Flight Center in Huntsville is useful. Many of these milestones signal changes in the work force composition. If a key design review reveals that further work is necessary or an engine test fails, for example, then the employment shift expected to take place will be delayed.

A further check and aid in revisions is the company's Affirmative Action Plan. By obtaining annual copies of the Plan, prior years' projections by the Early Warning System can be compared with the actuals from the Affirmative Action Plan, and the company's expected employment for the coming year in the Affirmative Action Plan can be compared with the Early Warning System projections. This can be done for total employment and for broad occupational groups.

Comparison of NPA Projections with Projections Using Industry Data. In the section on projecting the occupational distribution for Rocketdyne, it was mentioned that a significantly different occupational profile would have resulted had the California census data been used exclusively in making the occupational projections. It will be remembered that the census data were used to "fill in" occupations which could not be determined from NASA or company data, and that this included the distribution of occupations within the professional and technical and clerical groups and a few craftsmen and operative positions. Table 21 compares the distribution of employment by occupation projected for fiscal years 1973, 1974 and 1975, with the census distribution. The major differences are in the craftsmen and operatives and professional and technical groups. For example, machinists would account for 10 percent of total employment using the census data, but not more than 6 percent using company estimates. This difference is likely the result of differences in products, where the industry data includes producers of conventional aircraft and frames, which would require machinists and other machine operators for metal cutting and stamping operations. It is interesting that the percentages for support personnel, such as managers, clerical workers and service workers and laborers, are similar in both the census and company data.

Can industry data be used to generate estimates of total employment? The data indicate that estimates of total employment based on industry statistics on employment and value added can show substantial differences when compared with the projections made on the basis of company and NASA data. As mentioned in the section on data sources,

Table 21

Comparison of Projected Occupational Distribution at Rocketdyne FY 1973, 1974, 1975 With 1970 California Census Distribution for Aircraft Parts Industry

	Projected Distribution at Rocketdyne			1970 California Census Distribution, Aircraft & Parts Industry
	1973	1974	1975	
Total Rocketdyne	100.0%	100.0%	100.0%	100.0%
Professional, Technical and Kindred	46.5	41.0	36.0	28.9
Scientists and Engineers	26.5	23.4	20.5	16.5
Other Professional	12.3	10.8	9.5	7.6
Technical	5.6	4.9	4.3	3.5
Draftsmen	2.1	1.9	1.7	1.3
Managerial and Sales	9.0	9.0	9.0	6.4
Craftsmen, Operatives and Kindred	26.0	31.5	36.5	44.7
Toolmakers	2.7	3.8	2.3	2.3
Machinists	4.7	6.1	5.9	9.8
Welders	1.5	2.0	2.0	1.1
Sheetmetal Fabricators	2.2	3.0	3.4	1.2
Precision Assemblers	4.2 < 1.4	4.4 < 1.2	5.9 < 1.8	= 7.2
Other Assemblers	2.8	3.2	4.1	
Foremen	2.2	2.4	3.4	4.6
Checkers and Examiners	1.7	1.9	2.7	3.7
Engine Mechanics and Repairmen	2.5	2.7	3.9	5.3
Electricians	.5	.5	.7	1.0
Pattern and Model Makers	.4	.4	.6	.8
Other	3.6	4.0	5.6	7.6
Clerical Workers	15.5	15.5	15.5	17.8
Secretaries, Steno., Typists	5.1	5.1	5.1	5.9
Clerks	4.5	4.5	4.5	5.1
Office Machine Operators	1.2	1.2	1.2	1.4
Other	4.7	4.7	4.7	5.4
Service Workers and Laborers	3.0	3.0	3.0	2.2

Note: Details may not add to totals due to rounding.

industry data on a five-digit level, and on a three-digit level for the Los Angeles/Long Beach SMSA (in which the Rocketdyne plant is located), were available from the 1967 Census of Manufacturers. Data on industry shipping to NASA were available on a four-digit level for 1970 in Shipments of Defense Oriented Industries, 1970. The specific industries and SIC code numbers are given below:

(1) 1967 Census of Manufacturers

  (a) R & D in Missiles and Space Vehicle Engines or Propulsion Units, SIC 37226

  (b) Aircraft and Parts (Los Angeles/Long Beach SMSA), SIC 372

(2) Shipments of Defense Oriented Industries, 1970

  (a) Aircraft Engines and Parts (contractors with shipments to NASA), SIC 3722

Coefficients of employment per $1 million of value added were computed from the industry data. The coefficients were then adjusted to the 1973 levels for prices and productivity using unpublished data from the BLS Office of Productivity and Technology.

Before these coefficients can be compared with the coefficient derived from the in-house expenditures, a minor adjustment is needed.

The in-house and value added concepts, while essentially the same, have one difference. The value of subcontracts, supplies, materials, fuels and electric energy are excluded from both; however, the treatment of services such as wholesale and retail trade, finance, insurance, real estate, etc. is somewhat different. The in-house concept excludes all services, while value added does not. The value of these services was estimated by consulting the U. S. Department of Commerce input-output matrix for 1963.[1/]

[1/] U. S. Department of Commerce, Office of Business Economics, Input-Output Structure of the U.S. Economy: 1963, Vol. 2 - Direct Requirements for Detailed Industries, 1969.

These services account for 6.6 percent of the total value of output in the Aircraft Engines and Parts industry. For purposes of comparison with the industry data, the manpower coefficient based on company data was appropriately adjusted so that it expressed employment per $1 million of value added rather than per $1 million of in-house expenditures. The coefficients and the estimated employment derived from them on the SSME for fiscal year 1973 are shown in Table 22.

Table 22

Comparison of Coefficients of Employment Per $1 Million of Value Added from Company and Industry Sources, and Resulting Employment Estimate on the SSME, FY 1973

Source of Estimate	Employment Per $1 Million of Value Added	Estimated Employment on SSME in FY 1973
1. Estimate Based on NASA and Company Data	40	1,196
2. Estimate Based on 1967 Census of Manufacturers		
a. R&D Missile and Space Vehicle Engines	48	1,430
b. Aircraft and Parts Industry, Los Angeles/Long Beach SMSA	48	1,430
3. Estimate Based on Shipments of Defense Oriented Industries, 1970		
a. Aircraft Engines and Parts Industry Shipments to NASA	54	1,609

Note: Value added for the SSME was estimated at $49.8 million. Total cost was $42.8 million, of which $27.0 million was spent in-house. Value added was estimated by adding 6.6% of total cost to the in-house cost to account for services excluded from in-house cost but included in value added.

Projections based on Census of Manufacturers data would have resulted in a 20 percent overestimate as compared to the figures provided by NASA and company data, while use of the data in Shipments of Defense Oriented Industries would have been high by almost 35 percent.

The percent differences are reduced somewhat when employment on other projects at Rocketdyne are added in to obtain total plant employment estimates. Employment on other projects in 1973 was estimated from company data to be 1,948 workers.

The addition of these 1,948 to the alternative estimates for the SSME result in the following total plant employment:

Source of Estimate	
1. Estimate based on NASA and Company Data	3,144
2. Estimate based on 1967 Census of Manufacturers	
a) R & D in Missile and Space Vehicle Engines	3,378
b) Aircraft and Parts Industry, Los Angeles/ Long Beach SMSA	3,378
3. Estimate Based on Shipments of Defense Oriented Industries, 1970	3,557

Because employment on other projects is expected to account for over half of total plant employment, and this estimate is "fixed", the error in using industry data for the SSME portion is reduced to 7 percent using the 1967 Census of Manufacturers data and 13 percent using the Shipments of Defense Oriented Industries, 1970 data. As the SSME accounts for a greater proportion of total plant employment in future years, the differences between company and industry-based projections will increase.

These comparisons reveal that projections of even total employment on a project based on detailed industry-wide data can have significant margins of error. When combined with independent estimates of other work at the plant these differences may be mitigated, depending on the proportion of the plant work force which is engaged in other work. Many contracts chosen for study by an Early Warning System are of such magnitude that they would normally account for substantial portions of the total plant work force, and thus the margin of error using industry data can be substantial.

III. The Space Division Orbiter Project

Introduction. The space orbiter is the single largest component in the space shuttle effort, with an estimated cost of $2.6 billion. As of the end of FY 1974 initial design of the Orbiter has been completed, and production of a test vehicle has begun. Full production of the approximately half dozen flight vehicles is expected to begin during FY 1976. The Orbiter is being manufactured by the Space Division of Rockwell International in Downey, California, which is located in the Los Angeles/Long Beach SMSA.

Data and Data Sources. Because the decision to study the Orbiter was made during the last three months of this project, certain data that would otherwise have been obtained and incorporated into the projections could not be used. For example, the Space Division's Affirmative Action Plan would have been used to provide firm-specific data of the present and anticipated 1975 distribution of the work force by broad occupational groups. (In the case of Rocketdyne, the AAP served as the basis for linking the more detailed census occupations to the broad occupational groups.) However, it takes several months to obtain an Affirmative Action Plan and the AAP for the Space Division could not be used.

Working through the Division of Resource Analysis at NASA, data on expected total and "in-house" outlays, total direct man-years, and man-years by departmental categories were obtained for fiscal years 1974 and 1975. This data, in conjunction with the detailed occupational data from the 1970 California census for the aircraft and parts industry, and data from the Rocketdyne experience served as the basis for the employment projections. BLS data on deaths and retirements by occupation were used to estimate the number of job vacancies from this source.

Projection Procedures. The six steps below summarize the procedures employed in making the occupational projections. They are essentially the same as those used for the Rocketdyne project and recommended for most NASA procurements. They are:

1. Determining total and in-house dollars for the Orbiter by fiscal year;
2. Determining the relationship between the in-house dollars and total project manpower requirements at the plant;
3. Adding the expected employment from other projects to the Orbiter total to obtain total plant employment;
4. Using the departmental groupings provided by NASA to estimate employment by broad occupational groups consistent with census occupational definitions;
5. Using the detailed census occupational data for the aircraft industry to estimate employment in individual occupations; and
6. Adjusting occupational figures from #5 for deaths and retirements to obtain estimated job openings.

1. Determining total and in-house dollars for the Orbiter by fiscal year:

The Division of Resource Analysis provided estimated total and in-house outlays for the Orbiter contract by quarters for fiscal years 1974 and 1975 (see Table 23).

Total outlays for the project are expected to more than double on an annual basis, but the critical in-house figure is expected to increase somewhat less rapidly - by 84 percent. This is due to an increase in the percentage to be spent on subcontracts and materials, which NASA expects to stabilize at about one third.

Table 23

Estimated Outlays for Orbiter by Quarter,
Fiscal Years 1974 and 1975
(in millions of dollars)

	FY 1974 (by quarter)					FY 1975 (by quarter)				
Outlays	1st	2nd	3rd	4th	Total	1st	2nd	3rd	4th	Total
Total Outlays	39	51	84	117	291	135	141	159	174	609
In-House Outlays	30	39	60	78	207	87	87	99	108	381
In-House Outlays as a Percentage of Total	.77	.76	.71	.67	.71	.64	.62	.62	.62	.63

2. Determining the relationship between the in-house dollars and total project manpower required at the plant:

NASA also provided estimates of the direct manpower required by quarter to correspond to the expenditure data discussed above in #1. This figure includes primarily those individuals engaged in such activities as design and engineering, and manufacturing and tooling. Administrative, supervisory, and other support activities, the so-called overhead work force, must be added to this total. Based on detailed budget figures for FY 1974 showing outlays for direct and overhead labor, and past experience on NASA contracts, overhead employment was estimated at 90 percent of direct. This is also consistent with the overhead percentages used in the Rocketdyne award (see Appendix A, pp.36-38) which ranged from 100 percent to 76 percent depending on the work phase.

The manpower can then be taken as a ratio of expenditures (i.e., employment per $10,000 of in-house outlays) to obtain a manpower coefficient. It is important to have an idea of the manpower required per unit of expenditure in order to adapt the employment projection to changes in budget allocations, or to estimate the manpower for future time periods where the dollar expenditures are known but no official manpower figures are available, or to assess the impact of alternative budget levels on manpower requirements. Table 24 presents the NASA estimates of direct manpower and the estimates of overhead manpower associated with it. Also shown is the manpower ratio, which relates the manpower back to the expenditure estimates in Table 23 While the quarterly ratios show some fluctuation, the annual coefficients remain unchanged from 1974 to 1975.

Table 24

Man-Years of Work on Orbiter at Space Division
by Quarter, Fiscal Years 1974 and 1975

	FY 1974 (by quarter)					FY 1975 (by quarter)				
Work Effort	1st	2nd	3rd	4th	Total	1st	2nd	3rd	4th	Total
Direct Manpower	700	1,000	1,325	1,600	4,625	1,800	1,975	2,175	2,372	8,325
Overhead Manpower	630	900	1,192	1,440	4,162	1,620	1,777	1,958	2,137	7,492
Total Manpower	1,330	1,900	2,517	3,040	8,787	3,420	3,752	4,133	4,512	15,817
In-House Outlays (in millions of $)	30	39	60	78	207	87	87	99	108	381
Man-Years per $10,000 of In-House Outlays	.44	.49	.42	.39	.42	.39	.43	.42	.42	.42

3. Adding the expected employment from other projects to the Orbiter total to obtain total plant employment.

Because of potential shifting of manpower from other projects at the plant which may decline over the next year or so to the Orbiter project, which is expected to increase, it is important to take account of the entire plant work force for the period under investigation. The Space Division currently has two other projects, both of which are expected to decline over the next fiscal year. Employment on Skylab, according to NASA estimates, will decline from about 675 at the beginning of the 1974 fiscal year to only about 20 by year's end, and will require only a handful of workers in FY 1975. Work on the joint U.S.-Soviet space mission (Soyoz) is expected to shift to the launch site and mission control center in succeeding months. Consequently, employment on this project at the Space Division plant is expected to decline from 1665 to 950 during FY 1974, and decline further to 418 by the end of FY 1975. These estimates are based on NASA data on direct manpower and by estimating overhead manpower at 90 percent of the direct.

The expected employment levels at the beginning and end of the 1975 fiscal year for the three projects (Orbiter, Soyoz and Skylab) are displayed in Table 25.

Table 25

Projected Employment at Space Division
by Project, Fiscal Year 1975

Project	7/1/74	6/30/75	Employment Change 7/1/74-6/30/75
ORBITER			
Direct	6,800	9,900	+ 3,100
Overhead	6,120	8,910	+ 2,790
Total	12,920	18,810	+ 5,890
SKYLAB			
Direct	10	6	- 4
Overhead	9	5	- 4
Total	19	11	- 8
SOYOZ			
Direct	500	220	- 280
Overhead	450	198	- 252
Total	950	418	- 532
ALL PROJECTS[1]			
Direct	7,310	10,126	+ 2,816
Overhead	6,579	9,113	+ 2,534
Total	13,889	19,239	+ 5,350

---

[1] The total for all projects is a "net" figure and assumes that all of those workers laid-off of Skylab and Soyoz will have skills needed on the Orbiter Project.

4. Using the departmental categories provided by NASA to estimate employment by broad occupational groups consistent with census occupational definitions.

Contacts with Space Division officials revealed that they had no concrete projections of their manpower needs by occupation for the coming year. As previously stated, the time frame for making projections precluded the acquisition of a copy of the company's Affirmative Action Plan, which would have provided baseline data on employment by broad occupational groups (e.g., professional and technical, craftsmen and operatives, etc.). Consequently, the projection procedure used relied on NASA projections of employment by departmental category (engineering, manufacturing and tooling, and other direct manpower) and the California census data on employment by occupation for the aircraft industry, which is heavily characterized by aerospace work. The specific steps in the procedure were: (a) use NASA data to estimate departmental categories (e.g., engineering) for the three projects; (b) translate there categories into census occupational groups (e.g., professional and technical) using the experience of the Rocketdyne Division, the overall census distribution, and judgment; and (c) apply the distribution of occupations within each census group (e.g., tool makers and machinists in the craftsmen and operatives group) to the total derived for each group in (b) above. These steps are discussed in detail below.

(a) Using NASA data to estimate departmental categories for the three projects.

NASA figures for the Orbiter provided to NPA broke out the direct manpower into three categories: engineering, manufacturing and tooling, and other direct including quality assurance, materials and subcontracts management. For the Skylab and Soyoz projects precise details were not available; however, engineering manpower was estimated at 60 percent of total direct manpower by NASA officials. NPA then projected the manufacturing and tooling and other direct manpower to be proportional with the average relationship of the two groups in the Orbiter project. Since these two groups represent a small share of total plant employment, this judgment was felt to be justified in that even substantial error would not distort the overall pattern of employment by category for the plant as a whole. Table 26 shows the employment by departmental category and project estimated in this manner. The overhead employment which was estimated separately by NPA as previously explained (see page 66) is included as an additional category.

It can be seen that during the fiscal year, employment in the manufacturing and tooling group is expected to increase its share of the Orbiter and plant work force at the expense of the engineering category. This shift is consistent with the transition from the design to the production phase of work. Other direct manpower is expected to increase slightly relative to the total, reflecting the increased personnel needed to manage the higher level of subcontracts and materials purchased.

(b) Translating these categories into census occupational groups using the experience of the Rocketdyne Division, the overall census distribution, and judgment.

The procedure for converting the departmental categories to census occupational groups involved estimating the proportion of professional and technical, clerical, service workers and laborers in each category (engineering, manufacturing, other direct, and overhead). This was done based on a variety of data sources. The distribution of occupations within the manufacturing category obtained for the Rocketdyne plant served as a basis for estimating that group in the Space Division. In the other categories, informed judgments and overall relationship based on the census

Table 26

Employment by Occupational Category for Space Division, Fiscal Year 1975

	7/1/74		6/30/75	
Occupation	Number	% of Total	Number	% of Total
ORBITER	12,920	100%	18,810	100%
Direct	6,800	53	9,900	53
Engineering	3,400	26	3,750	20
Manufacturing & Tooling	2,400	19	4,450	24
Other Direct	1,000	8	1,700	9
Overhead	6,120	47	8,910	47
SKYLAB	19	100%	11	100%
Direct	10	53	6	53
Engineering	6	32	3	32
Manufacturing & Tooling	3	15	2	15
Other Direct	1	6	1	6
Overhead	9	47	5	47
SOYOZ	950	100%	418	100%
Direct	500	53	220	52
Engineering	300	32	132	32
Manufacturing & Tooling	140	15	62	15
Other Direct	60	6	26	6
Overhead	450	47	198	47
ALL PROJECTS	13,889	100%	19,239	100%
Direct	7,310	53	10,126	53
Engineering	3,706	27	3,885	20
Manufacturing & Tooling	2,543	18	4,514	24
Other Direct	1,061	8	1,727	9
Overhead	6,579	47	9,113	47

data were used. For example, the engineering category by its nature must contain primarily professional and technical personnel, with some clerical workers for support. According to census data for the industry, for every two professional, technical, managerial and sales workers (as a group), there is one clerical worker. This relationship was applied to all categories except manufacturing, where the distribution of occupational groups was derived from the Rocketdyne experience. Service workers and laborers were judged to be included in the overhead category only. Census data indicate that this group makes up about 2.5 percent of the total work force. Since the overhead category was 47 percent of total employment (see Table 26), about 5 percent of that category would need to be service workers and laborers in order to have a total employment representation of 2.5 percent (.05 X .47 = .024). The approach, therefore, was to fit as many known pieces into the estimates as possible to arrive at an eventual distribution that appeared correct based on the particular work phase of the projects. The distribution of census occupations within each category used is shown in Table 27.

(c) Applying the distribution of each census group to the NASA departmental categories in (a) above to obtain employment by broad census groups.

While the distribution of census groups within categories remains unchanged, the overall occupational profile changes as the "weight" of each category changes. For example, as the manufacturing and tooling category increases its share of total employment from 18 to 24 percent (see Table 26), considerably more job opportunities will be generated for craftsmen and operatives than any other group since they account for 85 percent of manufacturing and tooling employment. Once the distribution of census groups within each category is applied to the employment

Table 27

Conversion of Space Division Departmental Categories to Census Occupational Groups

Space Division Category	Census Group	Percent Distribution of Census Group
Engineering		100%
	Professional & Technical	53
	Managerial & Sales	12
	Clerical	35
Manufacturing & Tooling		100%
	Professional & Technical	10
	Managerial & Sales	2
	Craftsmen & Operatives	85
	Clerical	35
Other Direct		100%
	Professional & Technical	53
	Managerial & Sales	12
	Clerical	35
Overhead		100%
	Professional & Technical	47
	Managerial & Sales	11
	Craftsmen & Operatives	8
	Clerical	25
	Service Workers & Laborers	5

for the category, it can be summed across all categories to determine employment by census group for the entire plant. The resulting occupational profiles for 1975 are shown in Table 28. Professional and technical, managerial and sales, and clerical workers are expected to account for a somewhat smaller proportion of total employment over the period, reflecting the shift toward production. Managerial and sales might normally be expected to decline further relative to other occupations, but substantial subcontract management responsibilities will affect much of the otherwise expected decline.

Table 28

Projected Employment at Space Division
by Broad Occupational Groups, Fiscal Year 1975

	7/1/74		1/1/75		6/30/75	
Occupation	Number	% of Total	Number	% of Total	Number	% of Total
Professional & Technical	5,912	42.6%	6,701	41.1%	7,750	40.3%
Managerial & Sales	1,310	9.4	1,484	9.1	1,716	8.9
Craftsmen & Operatives	2,681	19.3	3,619	22.2	4,560	23.7
Clerical	3,653	26.3	4,109	25.2	4,752	24.7
Service Workers & Laborers	333	2.4	391	2.4	461	2.4
Total	13,889	100.0%	16,304	100.0%	19,239	100.0%

5. Using the detailed census occupational data for the aircraft industry to estimate individual occupations.

As in the case of Rocketdyne, the detailed occupational estimates were derived by applying the distribution of occupations within each group obtained from the 1970 California census for the aircraft and parts industry (SIC 372) to the group total derived in #4 above. The projections, therefore, are sensitive to changes in production mix (i.e., by increasing or decreasing professional and technical workers at the expense of craftsmen and operatives) but individual occupations within each group fluctuate proportionally with changes in the group total. The only exception to this is in the use of foremen which were projected to increase somewhat more slowly than other craftsmen and operative skills reflecting the supervisory economies of a larger productive work force. This was considered the best procedure, given the limitation in the data, and was expected to reasonably reflect the changes in occupational structure over a period of a year.

Table 29 shows the conversion from broad occupational group totals to detailed occupational estimates using the census distribution within the craftsmen and operative and clerical groups.

Table 29

Deriving Detailed Occupational Estimates at the Space Division from California Census Distribution

Occupation	Broad Occupational Groups Employment			Adjusted California Census Distribution			Detailed Occupational Employment		
	7/1/74	1/1/75	6/30/75	7/1/74	1/1/75	6/30/75	7/1/74	1/1/75	6/30/75
Total	13,899	16,304	19,239				13,889	16,304	19,239
Professional, Technical & Kindred	5,912	6,701	7,750				5,912	6,701	7,750
Managerial & Sales	1,310	1,484	1,716				1,310	1,484	1,716
Craftsmen & Operatives	2,681	3,619	4,560	100.0%	100.0%	100.0%	2,681	3,619	4,560
Tool Makers				5.0	5.1	5.1	134	184	234
Machinists (including machine operators)				21.3	21.7	21.9	572	785	1,000
Welders				2.4	2.4	2.5	64	88	112
Sheet Metal Fabrication				2.6	2.7	2.7	70	96	123
Assemblers				15.9	16.2	16.3	426	586	745
Foremen				12.7	11.2	10.3	340	404	469
Checkers & Examiners				8.1	8.2	8.3	216	296	377
Engine Mechanics & Repairmen				11.6	11.7	11.9	310	425	541
Electricians				2.2	2.2	2.2	58	78	100
Pattern & Model Makers				1.7	1.7	1.7	45	61	77
All Other				16.6	17.0	17.1	466	616	782
Clerical	3,653	4,109	4,752	100.0%	100.0%	100.0%	3,653	4,109	4,752
Secretaries, Steno., Typists				33.1	33.1	33.1	1,210	1,361	1,574
Clerks				28.7	28.7	28.7	1,047	1,178	1,362
Office Machine Operators				7.9	7.9	7.9	287	323	374
Other Clerical				30.3	30.3	30.3	1,109	1,247	1,442
Service Workers & Laborers	333	391	461				333	391	461

6. Adjusting occupational figure from #1 for deaths and retirements to obtain estimated job openings.

Projections developed in #5 above indicate the number of jobs needed at any point in time. The number of hires to fill these jobs is somewhat higher because of turnover. Consistent with the projection procedures for the other contracts studied, only that turnover resulting from deaths and retirements is taken into account because of the stability of these rates relative to the more volatile rate for quits.

The source of the estimates for deaths and retirements was Tomorrow's Manpower Needs,[1] which provides death and retirement rates by occupation. In the craftsmen and operatives group the overall rate for men was used for all individual occupations, as the rates for specific occupational titles vary little from the group rate. For clerical workers, deaths and retirements were estimated using the rate for female workers for the category. Death and retirement rates for service workers and laborers was based on an average of the rates for those specific occupations which were predominant in the census group for the industry (guards and watchmen, janitors and sextons, laborers excluding farm). Table 30 shows the employment growth and replacement needs at the Space Division for FY 1975. The death and retirement rates for clerical occupations and service workers and laborers are significantly higher than for the other occupations. The result of these adjustments is, therefore, to increase the job openings at the lower skilled levels. While only 23 percent of the projected

---

[1] U.S. Department of Labor, Bureau of Labor Statistics, Tomorrow's Manpower Needs, Vol. I, 1969.

Projected Employment Growth, Deaths and Retirements, and Hires at Space Division, Fiscal Year 1975

Occupation	Employment Growth		Deaths and Retirements			Total Hires	
	7/1/74-1/1/75	1/1/75-6/30/75	Annual Rate	7/1/74-1/1/75	1/1/75-6/30/75	7/1/74-1/1/75	1/1/75-6/30/75
Total	2,415	2,935	- %				
Professional, Technical & Kindred	789	1,049	1.6	50	58	839	1,107
Managerial & Sales	174	232	2.5	17	20	191	252
Craftsmen & Operatives	938	941	1.9	30	39	968	980
Tool Makers	50	50	1.9		2	52	52
Machinists (including machine operators)	213	215	1.9	6	8	219	223
Welders	24	24	1.9	1	1	25	25
Sheet Metal Fabrication	26	27	1.9	1	1	27	28
Assemblers	160	159	1.9	5	6	165	165
Foremen	64	65	1.9	3	4	67	69
Checkers & Examiners	80	81	1.9	2	3	82	84
Engine Mechanics & Repairmen	115	116	1.9	3	5	118	121
Electricians	20	22	1.9	1	1	21	23
Pattern & Model Makers	16	16	1.9	1	1	17	17
All Other	170	166	1.9	5	7	175	173
Clerical	456	643	4.9	95	109	551	752
Secretaries, Steno., Typists	151	213	4.9	31	36	182	249
Clerks	131	184	4.9	27	32	158	216
Office Machine Operators	36	51	4.9	8	9	44	60
Other Clerical	138	195	4.9	29	32	167	227
Service Workers & Laborers	58	70	3.5	6	7	64	77

openings due to employment growth were expected to be clerical, service workers and laborers (1,227 out of 5,350) in FY 1975, one half of the openings generated from deaths and retirements are expected to be in these groups (217 out of 432).

Updating the Projections. The critical variables which may affect the accuracy of the projections are changes in the level of budget appropriations and unanticipated changes or delays in the development process that would affect the occupational mix of the plant work force. Periodic contact with NASA officials can provide information on both these areas. If total expenditures are expected to be lower than initially estimated but the character of the work effort is to be essentially unchanged, then the occupational estimates can be scaled downward to conform to the revised total employment estimate derived by applying the overall manpower coefficient to the revised outlay estimate. If the character of the work effort is to be substantially different than originally anticipated, then this shift should be incorporated into the projections by modifying the weights applied to each of the departmental groupings based on the nature of the production shift, and the judgments of NASA officials.

Comparison of Projections with Projections Based on Industry Data Only. As with the projections prepared for the Rocketdyne Division, significant differences appear when comparing the NPA projections with those based solely on industry data. This is true both of estimates of total employment and the occupational figures. Table 31 compares estimates of employment for the Orbiter based on two Department of Commerce publications with the estimates based on NASA data for the project.

Table 31

Comparison of Coefficients of Employment per $1 Million of Value Added from NASA and Industry Sources, and Resulting Employment Estimate on the Orbiter, Fiscal Year 1974 (In 1974 Dollars)

Source of Estimate	Employment per $1 Million Value Added	Estimated Employment on Orbiter (In Man Years)
NASA Data for Orbiter Project	39	8,787
1967 Census of Manufacturers		
Aircraft and Parts Industry, Los Angeles/Long Beach SMSA	43	9,720
Shipments of Defense Oriented Industries, 1970		
Aircraft Engines and Parts Industry, Shipments to NASA	49	11,075

Note: Value added for the Orbiter was estimated at $226 million. Total cost was $291 million, of which $207 million was spent in-house. Value added was estimated by adding 6.6% of total cost to the in-house cost to account for services excluded from in-house cost but included in value added. (See p.59 of this Appendix for further explanation.) Employment coefficients were updated to reflect price level and productivity changes.

Estimates based on the Commerce Department data are as much as one fourth higher than the estimate based on NASA project-specific data.

Projections of individual occupations also show large discrepancies. Table 32 compares the actual figures used with the projection which would have resulted if the census distribution were applied to the same total employment. The principal difference in the two sets of projections is the far greater representation of craftsmen and operatives in the census figures than is actually anticipated. This reflects the fact that the census distribution reflects the "average" aircraft firm in California which involves conventional as well as jet and space vehicles, and assembly-line production operations as well as research and developmental efforts. The Orbiter is currently completing the design stages and would require more professional and technical workers (and therefore clerical workers as support) than would be the case when full production is achieved.

The Space Division experience, where very little time was spent in preparing the projections, confirms that the projection methodology developed is flexible. The proceedures used in the earlier NASA award were easily adapted to the more limited data availability of the Space Division contract, and the actual time spent in preparing the projections was far less than in the earlier award. This shows that projections can be made in a relatively short period of time and with a minimum of proprietary information from the contractor.

Table 32

Comparison of Projections Made for Space Division with Projections Using Only Census Data

	7/1/74		6/30/75	
Occupation	NPA	Census	NPA	Census
Total	13,889	13,889	19,239	19,239
Professional, Technical & Kindred	5,912	4,014	7,750	5,560
Managerial & Sales	1,310	889	1,716	1,231
Craftsmen & Operatives	2,681	6,208	4,560	8,599
Tool Makers	134	318	234	442
Machinists	572	1,361	1,000	1,885
Welders	64	153	112	212
Sheet Metal Fabrication	70	167	123	232
Assemblers	426	1,015	745	1,406
Foremen	340	639	469	885
Checkers & Examiners	216	513	377	711
Engine Mechanics & Repairmen	310	736	541	1,020
Electricians	58	137	100	189
Pattern & Model Makers	45	107	77	145
All Other	446	1,061	782	1,474
Clerical	3,653	2,472	4,752	3,425
Secretaries, Steno., Typists	1,210	819	1,574	1,135
Clerks	1,047	709	1,362	982
Office Machine Operators	287	194	374	269
Other Clerical	1,109	750	1,442	1,039
Service Workers & Laborers	333	306	461	424

IV. The Pullman-Standard Award

The award of a $216 million contract by the New York City Transit Authority (NYCTA) to the Pullman Car Works Plant in East Chicago for the purchase of 746 subway cars is financed jointly by NYCTA and the Urban Mass Transportation Administration (UMTA) of the Department of Transportation, with the Transit Authority paying one third and UMTA two thirds of the project cost. The Pullman award was selected for study for the following reasons. First, it was felt that UMTA would have an increasing role over the next few years as the goals of urban development, pollution abatement, and energy reduction were pursued, and that an operating Early Warning System would therefore be involved in similar projects in future years. Second, there is a major difference between the Pullman award and the other two contracts studied, in that the Pullman award is a "grant" rather than a "contract." NASA contracted directly with Rocketdyne as did the Corps of Engineers with Dravo, Groves and Newburg, while UMTA gave funds to NYCTA, who contracted with Pullman-Standard. NYCTA, rather than a Federal government agency, therefore, is the contracting agency. Besides receiving monthly accounting statements, UMTA exercises no direct control over the project. However, the contractor must still abide by all Federal laws regarding equal employment certification, etc.

Data and Data Sources. Data used to prepare the final projections for Pullman were primarily obtained from two sources: 1) the New York City Transit Authority, and 2) the company. Aside from these two primary sources, data on labor turnover in the industry were obtained from

Bureau of Labor Statistics publication Employment and Earnings. These data were used to adjust the projections for turnover.

1. New York City Transit Authority. The Transit Authority provided NPA with several important documents. Most important was the payment and delivery schedule, Figure 8, which is shown on the following page. Partial payments are made at specified stages of a car's completion and the final payment is made upon acceptance of the product (i.e., a 20 percent payment for a car at the 25% completion stage . . . the final 10% payment upon acceptance). From this schedule monthly outlays by Pullman were derived. NYCTA also provided a copy of the Pullman contract, and discussions with Transit Authority officials provided an estimate of the "value added" for the contract. NYCTA's estimate was based on past experience with similar procurements and the known value of subcontracts by Pullman. This information was used to compare the company-based estimates with the estimated total employment for the contract based on employment and value added from industry data.

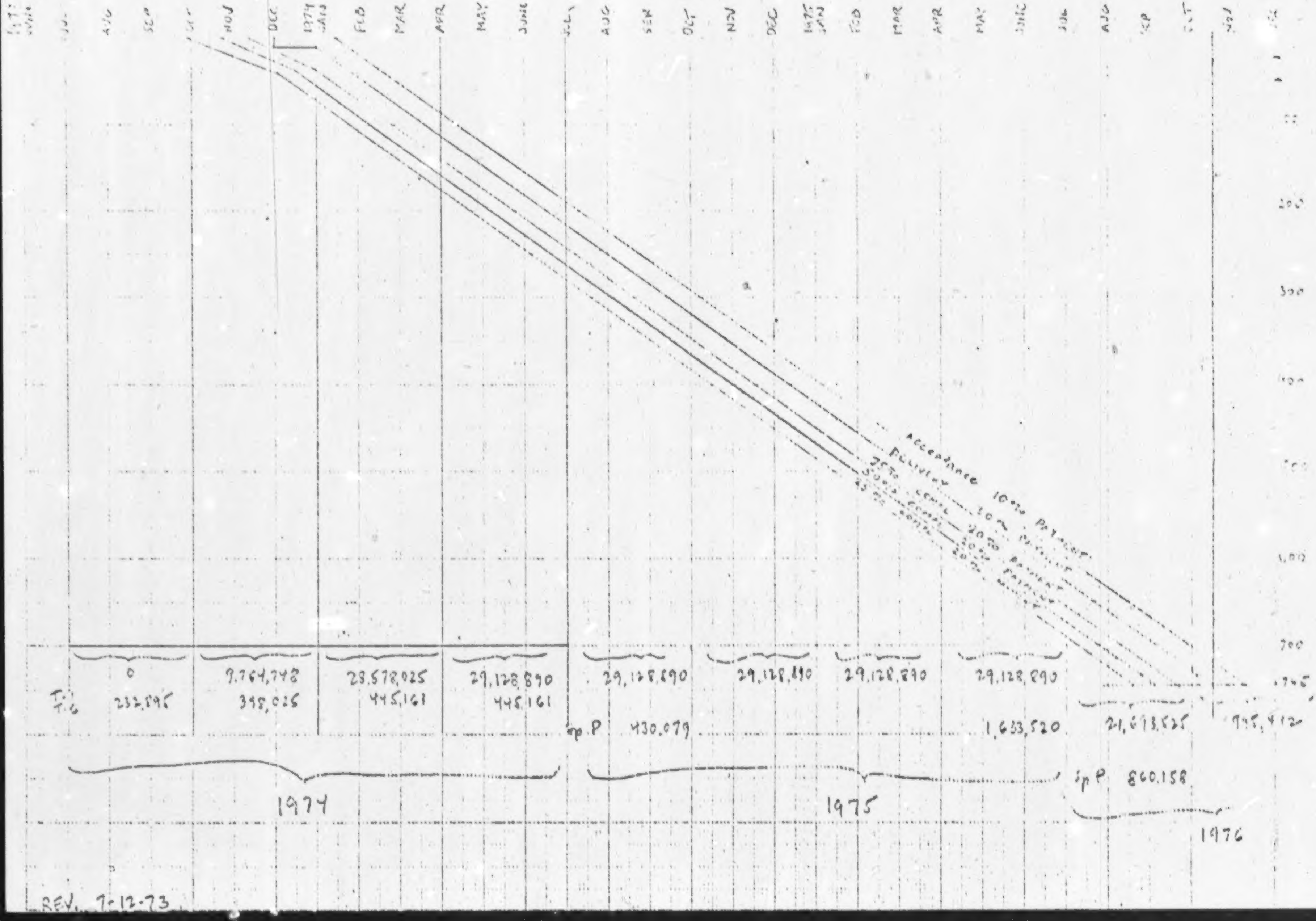
2. Pullman-Standard. After initially showing reluctance to provide data on the NYCTA contract, the company did provide sufficient information to permit the preparation of occupational projections. This information included: the current employment by occupation at the plant; the number of workers by occupation needed to produce two cars per day; data on the manpower required on a smaller contract with AMTRAK for refurbishing passenger cars; overall plant data on turnover; and the number of workers by occupation currently possessing "recall" rights.

84A

BEST COPY AVAILABLE

Figure 8

Payment and Delivery Schedule for Pullman, Provided by New York City Transit Authority



3. Department of Labor. Data on turnover in the Railroad Equipment Manufacturing industry (SIC 374) were obtained from the monthly publication of such data in Employment and Earnings.

Projection Procedures. The Pullman projection procedure is almost identical to the one detailed for Rocketdyne. The only difference is the "form" in which the original data, on which the projections are based, were available. The steps are listed below and then discussed in detail:

1. Determining the anticipated monthly expenditure level for the project;
2. Deriving a coefficient of employment per $1 million of monthly expenditures;
3. Applying the coefficient from #2 to the anticipated monthly expenditure levels from # 1 to determine total employment on the NYCTA contract;
4. Determining the occupational distribution for the contract, and applying this distribution to the monthly total employment from #3 to obtain occupational employment by month;
5. Adding on to #4 the number of workers by occupation required to complete other contracts at the plant; and
6. Deriving projected net job openings per month by adjusting the monthly employment projections for recalls and turnover (deaths, retirements and discharges), and subtracting the adjusted projected monthly level from the previous month.

1. Determining the expected monthly expenditure level for the project:

The delivery and payment schedule shown previously in Figure 8 provided the basis for projecting monthly expenditures. After the first four months of production, output of cars is expected to follow a virtual straight line process until the final four months, when no new cars will be started but several cars will still be in the final stages of production. The schedule also gives the expected quarterly payments to Pullman. Payments, however, do not represent production flow, because a percentage of the payments are made upon delivery and acceptance of the cars, rather than at the time they are actually completed. Monthly payments, therefore, had to be converted to the dollar flow related to production. This was done by using data in the payment schedule.

The schedule of payments is based on a "sliding scale" relative to the completion percentage of each car, as follows:

Percentage of Car Completed During Month	Percentage of Payment for Car
25%	20%
50%	40%
75%	60%
Delivery	90%
Acceptance	100%

By breaking the schedule into the monthly change in the number of cars 25% completed, the number 50% completed, etc., the flow of cars in the production process can be determined. This process can then be converted into dollar expenditures based on the unit price of a car. For example, if from month X to month Y the number of cars 25 percent completed increased by 50 and the unit cost for a car is $278,000, then $3,475,000 was expended in producing the cars. That is, the unit price multiplied by the percentage completed multiplied by the number of cars achieving the percentage gives the dollar outlays. In this example: ($278,000)(.25)(50) = $3,475,000. Using this technique, the expenditure pattern through 1974 was computed, as shown in Table 33.

Discussions with NYCTA and Pullman officials revealed that because of design difficulties, a six-month delay was expected in the start of production. This demonstrates the need for having a convenient mechanism for revising projections, and affords an opportunity to demonstrate it.

While production was to be delayed six months, both NYCTA and Pullman stated that the final delivery date was expected to be met. Under these conditions the adjustment procedure was to: 1) move the projected expenditures for October-December 1973 to April-June 1974; and 2) redistribute the originally anticipated expenditures for the period throughout the remainder of the contract. This adjustment allows for the normal "start-up" curve at the beginning of the production process and then for the production peak at the appropriate level in order to meet the delivery dates.

The initial monthly outlays projections based on the delivery schedule and the projected outlays allowing for the six-month delay are displayed in Table 33. It can be seen that the monthly figures, once full production is reached, are virtually constant at about $11.6 million.

Table 33

Pullman Monthly Expenditures Based on NYCTA Payment Schedule
and Monthly Expenditures, Adjusted for Six-Month Delay

Month	Initial Outlays Projections	Adjusted Outlays Projections
1973		
October	$ 1,780,900	$ –
November	4,630,400	–
December	5,699,000	–
1974		
January	9,973,300	–
February	9,617,100	–
March	10,329,000	–
April	9,973,300	1,780,900
May	9,260,900	4,630,400
June	9,617,100	5,699,000
July	10,329,400	11,826,400
August	9,617,100	11,404,000
September	9,973,100	12,248,700
October	9,617,100	11,826,400
November	9,617,100	10,981,600
December	9,973,100	11,404,000
Average, July-December	9,854,500	11,615,200

2. Deriving a coefficient of employment per $1 million of expenditures:

Through a meeting with Pullman officials the work force breakdown required to produce two cars per day was determined at about 1,185 production, maintenance and service workers. With a unit price per car of approximately $278,000, this would mean that employment of 1,185 workers (the two-car-a-day work force) resulted from expenditures of $556,000 (the cost of two cars). On a per $1 million of expenditures basis, 2,131 workers are needed for every $1 million of daily expenditures. Putting this relationship on a monthly basis, to be consistent with the expenditure projections in Table 33, 101.5 workers are needed for every $1 million of monthly spending.[1/]

3. Applying the manpower coefficient to the monthly expenditures:

The coefficient of 101.5 workers per $1 million of monthly expenditures can now be applied to the projected monthly outlays shown previously in Table 33. Because monthly expenditures remain virtually constant once peak production is reached, the average employment for the July-December period was used in order to avoid showing monthly employment increases or decreases of a few percentage points each month.

The projected employment for the first six months is not identical with that obtained by applying the 101.5 coefficient to the appropriate

---

[1/] There are approximately 21 working days in a month. The coefficient of 2,131 is therefore divided by 21 to obtain the equivalent monthly coefficient.

dollar outlays. The payment schedule takes effect only when actual production and deliveries begin. However, there is also a design and testing period. Pullman had about 230 workers on-board in October 1973 fabricating parts, assembling components, and testing. Allowance must be made for this factor in making monthly employment estimates. Also, the required employment per $1 million of expenditures can be expected to be higher at lower levels of output (e.g., at the 1/2 car per day level). Table 34 compares the employment levels resulting from exact application of the coefficient with the employment level actually used based on the reasons given above.

Table 34

Total Employment at Pullman as Derived from Coefficient Compared with Employment Figures Actually Used, by Month, 1974

Month, 1974	Total Employment Based on Use of Coefficient	Total Employment as Finally Used
January	0	232
February	0	232
March	0	232
April	181	468
May	470	705
June	578	941
July	1,200	1,178
August	1,157	1,178
September	1,243	1,178
October	1,200	1,178
November	1,115	1,178
December	1,157	1,178
Average, July-December	1,178	1,178

4. Determining the distribution of employment by occupation and applying the distribution to the projected monthly employment totals from #3:

Pullman officials had provided details on the number of workers in each skill group needed to produce two cars per day. These figures are shown in Table 35:

Table 35

Work Force Required to Produce Two Cars Per Day at Pullman on the NYCTA Contract

Skill Group	Number of Workers	Distribution of Work Force
		%
Machine Operators (Punch, Shear, Press)	100	8.4%
Machine Operators (Hole and Milling)	20	1.7
Fitters	259	21.9
Joiners	120	10.1
Welders	60	5.1
Assemblers	84	7.1
Pipe Fitters	36	3.0
Electrical Workers	200	16.9
Painters	70	5.9
Service, Labor, Maintenance	236	19.9
Total	1,185	100.0

The service, labor and maintenance category includes such workers as tool and die makers, blacksmiths, drivers, material handlers, and other service and laborer jobs. Electrical workers include electricians, car wirers, and conduit installers. Fitters assemble the main parts of the car (i.e., sides), while assemblers install such hardware as ducts, ceilings and doors. Joiners fit and apply interior finishing materials, such as hand rails, fixtures, lockers, etc.

5. Determining the number and occupation of workers required on other projects:

Pullman officials indicated that they do not expect to start work on new contracts until the contract with NYCTA is near completion. They currently have an agreement with AMTRAK to refurbish railroad passenger cars. This is expected to involve about 80 workers over the next year or so. The occupations required will differ somewhat from those required on the NYCTA contract because of differences in the type of work involved (refurbishing for AMTRAK, new car construction for NYCTA). This estimated distribution of workers for AMTRAK, taking these differences into account, is shown in Table 36.

Table 36

Work Force Required to Refurbish Cars for AMTRAK at Pullman

Skill Group	Number of Workers	Distribution of Work Force
Machine Operators	1	1.2%
Fitters	1	1.2
Joiners	13	15.9
Welders	6	7.3
Assemblers	28	34.2
Pipe Fitters	4	4.9
Electrical Workers	21	25.6
Painters	7	8.5
Service, Labor, Maintenance	1	1.2
Total	82	100.0

The skills needed for both the NYCTA and AMTRAK contracts can be combined and compared with the work force on-board in October 1973 (figures provided by Pullman). It can be seen from Table 37 that the Pullman work force will more than quadruple when peak employment occurs. From the monthly expenditures displayed in Table 33, it appears that this peak is expected in July of 1974, and that outlays for the production of cars are slated to begin in April 1974. The Pullman work force should therefore remain constant at 307 until April and rise rapidly to the peak level of 1,260 by July. Occupational employment during the April-July period is projected to increase in a straight line manner from the 307 level to 1,260. On a straight line basis, the monthly work force

Table 37

Pullman Employment in October 1973 Compared with Expected Peak Employment Level in July 1974, by Occupation

Occupation	October 1973 Work Force	July 1974 Peak Work Force	Increase in Work Force, 10/73-7/74
Machine Operators (Punch, Shear, Press)	27	100	73
Machine Operators (Hole and Milling)	4	20	16
Fitters	42	285	243
Joiners	17	132	115
Welders	18	66	48
Assemblers	6	84	78
Pipe Fitters	12	40	28
Electrical Workers	12	220	208
Painters	12	77	65
Service, Labor, Maintenance	157	236	79
Total	307	1,260	953

profiles from January to July 1974 would appear as shown in Table 38. After July, the work force is expected to remain at the July level through the end of the year as output is projected to remain constant.

6. Deriving projected net job openings by month by adjusting the monthly employment projections for recalls and turnover (deaths, retirements and discharges) and subtracting the adjusted projected monthly levels from the previous month:

For manpower training and recruitment purposes, it is important to know not the number of "jobs", but the number of "hires" which will occur.

Table 38

Pullman Work Force by Month, January-December 1974, by Occupation

Occupation	1/74	2/74	3/74	4/74	5/74	6/74	7/74	8/74	9/74	10/74	11/74	12/74
Machine Operators (Punch, Shear, Press)	27	27	27	45	63	82	100	100	100	100	100	100
Machine Operators (Hole and Milling)	4	4	4	8	12	16	20	20	20	20	20	20
Fitters	42	42	42	96	150	204	258	258	258	258	258	258
Joiners	17	17	17	46	75	104	132	132	132	132	132	132
Welders	13	18	18	30	42	54	66	66	66	66	66	66
Assemblers	6	6	6	32	58	84	111	111	111	111	111	111
Pipe Fitters	12	12	12	19	26	33	40	40	40	40	40	40
Electrical Workers	12	12	12	64	116	168	220	220	220	220	220	220
Painters	12	12	12	28	44	60	77	77	77	77	77	77
Service, Labor, Maintenance	157	157	157	177	197	217	236	236	236	236	236	236
Total	307	307	307	545	783	1,022	1,260	1,260	1,260	1,260	1,260	1,260

Allowance for deaths, retirements and discharges will have the effect of increasing the number of new hires above the number of jobs. Recall of workers currently on lay-off status has the reverse effect - it reduces the need to train or recruit workers to fill job slots. The company has 167 workers on lay-off status whom it expects to recall as production increases.

The occupations of the workers whom Pullman expects to recall (figures provided by Pullman to NPA) are shown below:

Fitters	47
Joiners	22
Welders	7
Assemblers	51
Electrical Workers	20
Painters	20
Total Available for Recall	167

Turnover is due to separations resulting from quits, lay-offs, deaths, retirements and discharges. Lay-offs were not considered by NPA in projecting the turnover rate because the plant is in a period of increasing employment. Company officials indicated that turnover for the plant ran at about 3 percent a month during 1973. This contrasts with an average for the industry of 2 percent a month (excluding separations resulting from lay-offs).[1/] Both these figures include quits, a factor too

---

[1/] U.S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings, March 1973, p.112.

volatile to allow for in making projections of job opportunities because it is affected by too many outside variables. Excluding the quits as well, the industry data shows a rate of 1 percent a month for separations related to deaths, retirements and discharges. The Pullman projections were adjusted for deaths, retirements and discharges at the industry figure, 1 percent a month, based on the expectation that appropriate recruitment and training programs could reduce the number of discharges which typically occur when large numbers of new workers are hired.

The projected monthly employment based on job count can now be translated into monthly hires by: 1) calculating the change in employment (job count) from one month to the next; 2) adding a 1 percent allowance for deaths, retirements and discharges to the job count for the month; and 3) subtracting the number of workers who can be "recalled" to fill the number of new positions generated by the increased job count and normal turnover.

In January and February, no increase in the job count is anticipated; however, several workers should need to be hired or recalled due to death, retirement, etc. In March, hiring for the April employment requirement of 239 additional jobs can be expected to begin, in addition to the hiring to replace the 1 percent of the work force which dies, retires, etc. By July, hiring should occur only to fill vacancies expected to arise from deaths, retirements and discharges. This will amount to 13 workers per month, or 76 workers from July to the end of the year. The results of these calculations are shown for the first and second halves of the year in Table 39.

Table 39

Deriving Projected New Hires at Pullman for Six-Month Periods, January-June 1974 and July-December 1974

	January-June 1974				July-December 1974			
Occupation	Job Count Change to Next Month	+ Deaths, Retirements, Discharges	- Recalls	= Total Hires for Period	Job Count Change to Next Month	+ Deaths, Retirements, Discharges	- Recalls	= Total Hires for Period
Machine Operators (Punch, Shear, Press)	73	4	0	77	0	6	0	6
Machine Operators (Hole and Milling)	16	0	0	16	0	1	0	1
Fitters	216	6	47	175	0	15	0	15
Joiners	115	4	22	97	0	8	0	8
Welders	48	2	7	43	0	4	0	4
Assemblers	105	2	51	56	0	7	0	7
Pipe Fitters	23	0	0	23	0	3	0	3
Electrical Workers	208	4	20	192	0	13	0	13
Painters	65	2	20	47	0	5	0	5
Service, Labor, Maintenance	79	11	0	90	0	14	0	14
Total	953	35	167	821	0	76	0	76

In the first six months of 1974, the total number of "jobs" is projected to increase by 953. Deaths and retirements will result in 35 additional vacancies; however, this will be more than offset by the recall of 167 workers previously laid off by the company. Total hires for the period will be substantial at 821. If the hiring were spread out equally throughout the period this would mean in excess of 135 hires per month. The bulk of the hires is likely to be in the final three months of the period, however, because of the time-phasing of production, and the monthly hires should therefore be substantially larger at the end than at the beginning of the January-June period. The second part of the year is projected to show no increase in jobs, as production reaches its peak. Normal deaths, retirements and discharges, however, will result in the need to replace about 75 workers. These workers will need to be recruited entirely from the outside, as the company will have exhausted its recall list during the first half of the year.

Occupations showing the largest increases will be fitters and electrical workers. Also increasing rapidly are joiners, assemblers, and service, labor and maintenance workers.

Employment Projections Compared with Projections Made from Industry Data. How close can projections based on macro data come to the projections based on company-specific data? The *1967 Census of Manufacturers*[1] provides data on employment, value added, and value of shipments on a five-digit

---

[1] U.S. Department of Commerce, Bureau of the Census, *Census of Manufacturers, 1967, Industry Series: Ship and Boat Building, Railroad and Miscellaneous Transportation Equipment*, MC 67(2)-37C, 1970, p.37.

SIC level of detail. The relevant industry is SIC 37423, Streetcars, Railroad and Streetcar Parts and Accessories. Within this industry separate data are available on those firms whose primary product shipments (streetcars, railroad and streetcar parts and accessories) are 75 percent or more of its total shipments. Generally, firms are classified into a particular product class (i.e., industry) when its shipments of that product exceed its shipments of other products. The data on 75 percent or more "specialization" of products should, therefore, provide the better data base for comparison with Pullman, which will be shipping 100 percent of its product into the product class SIC 37423.

Using the specialized segment of the industry, a coefficient of employment per $1 million of value added of 85.8 was derived. This figure must be adjusted to 1973 dollars. An unpublished price index from the BLS Office of Productivity and Technology for SIC 3742 was used for this purpose. Making the appropriate adjustment the employment per $1 million of value added in 1973 dollars would be 68.0. An adjustment for productivity increases during the period would also be in order; however, unpublished BLS data on output per man-hour for the railroad equipment industry indicates widely fluctuating annual changes. For example, after productivity increased at an annual rate of 7.1 percent from 1960 to 1965, it turned around and declined by 1.2 percent per year from 1965 to 1970. Under these conditions, it was felt most appropriate not to make any adjustment for productivity in the industry data, assuming that the decline in productivity during the latter part of the 1960's would be offset by increases during the 1970-1973 period, for which productivity data is not currently available. Finally, the coefficient must be converted to a coefficient of employment based on monthly, rather than annual, outlays. In other words, if 68.0 workers are required to produce $1 million of value added in a year, 12 times that number, or 816 workers, would be needed to produce $1 million of value added in one month.

The estimate of value added for the Pullman contract came from data and from discussions with officials at NYCTA. Based on prior experience in subway procurements and the specific items subcontracted for by Pullman, the NYCTA engineer for the Pullman contract estimated that about 15 percent of the value of the contract would be value added by Pullman-Standard. The rest would represent subcontracts for such items as the motor propulsion units (about 33 percent of total contract cost), the truck bodies (about 20 percent), brakes (about 10 percent) and other components.

Table 40 shows the employment estimate obtained by applying the employment per $1 million of monthly value added to the projected monthly value added at peak employment (estimated at 15 percent of total outlays):

Table 40

Deriving Peak Employment at Pullman on the NYCTA Contract, Based on Industry Data

1.	Employment per $1 Million of Monthly Value Added	816
2.	Projected Monthly Value Added at Peak Employment (in thousands)	$1,742
3.	Projected Employment at Peak (#1 x #2)	1,421

The 1,421 figure for workers, as derived in Table 40, is not strictly comparable to the 1,178 actually projected. This is because the former includes employment of professional and technical, managerial, and clerical workers, while the latter, based on company data, includes only production workers - craftsmen, operatives, service workers and laborers. Industry occupational data for the Railroad Car Manufacturing industry (SIC 374) in Illinois indicate that one third of the industry work force is in professional, technical, managerial and clerical occupations, while data in Pullman-Standard's Affirmative Action Plan show that 20 percent of the plant work force was in these occupations in 1972. Adjusting by the industry-wide data (reducing the 1,421 by one third), 948 workers would have been projected. Reducing by the Pullman figure of 20 percent, 1,137 workers would have been anticipated. The former figure is 20 percent lower than the one actually projected, and the latter only 4 percent off.

It is more difficult to compare the occupational detail from industry sources with that obtained from company data because of differences in occupational definitions and classifications. The most detailed occupation by industry breakdown available is on a three-digit SIC level for railroad equipment (SIC 374). It was felt that data based on the occupational profile of the industry in the state of Illinois would more closely reflect the Pullman profile than would a national profile, since the company is located in Chicago and would have a greater representation in the data base used. Unpublished data from the 1970 Census of Population was the source for the occupation by industry data for Illinois. Table 41 compares as closely as possible the occupational profiles of the census and company data. The distribution used excluded the professional and technical, managerial, sales, and clerical occupations, which together account for one third of all occupations in the census distribution, to be consistent with the company figures, which excluded these groups.

The greatest differences occur in the fitter and joiner groups, electrical workers, and machine operators. These differences probably reflect a heavy weighting of the census data toward railroad freight car production, as opposed to passenger or subway cars. The former would be likely to involve less finishing work (fitters and joiners), a less complex electrical system, and less fabrication of parts.

Appropriately adjusted industry-wide data were able to give a reasonable estimate of the total manpower needs at Pullman; however, any attempt to utilize the industry-occupational breakdown would have resulted in significant distortions of the firm's occupational needs. This is evident in the electrical worker category. Company estimates showed 17 percent of its production work force in this category, four times the proportion which was shown based on census occupational data.

Table 41

Comparison of Occupational Projections for the Pullman Work Force on the NYCTA Contract, Using Company and Industry-Wide Data

Company-Based Projection			Census-Based Projection		
Occupation	Number	% Distribution	Number	% Distribution	Occupation
Machine Operators (Punch, Shear, Press)	99	8.4%	47	4.1%	Punch and Stamping Press Operators, Other Cutting Machine Operators
Machine Operators (Hole and Milling)	20	1.7	195	17.1	Drill Press, Lathe, Milling, and Other Precision Machine Operators
Fitters	257	21.9			
	[376]	[32.0]	43	3.8	Structural Metal Crafts, Riviters and Fasteners
Joiners	119	10.1			
Welders	60	5.1	164	14.4	Welders and Flamecutters
Assemblers	83	7.1	85	7.5	Assemblers
Pipe Fitters	36	3.0	31	2.7	Plumbers and Pipe Fitters
Electrical Workers	199	16.9	46	4.0	Electricians
Painters	70	5.9	17	1.5	Painters (Manuf. Articles)
	-	-	94	8.3	Checkers and Examiners
Service, Labor, Maintenance	235	19.9	209	18.4	Service, Labor, Maintenance
	-	-	206	18.2	Other
Total	1,178	100.0	1,137	100.0	Total

Conclusion. Before the conference/workshop in Chicago, the projections developed by NPA through the cooperation of Pullman officials were reviewed by the Directors of Personnel and Production at the Pullman plant. After comparing the projected figures with their production schedule, these individuals were in agreement that the projections accurately reflected their view of the work flow, both in terms of the timing of the employment rise and the specific occupations involved.

It should be noted that while the projections relied on company data for the distribution of occupational skills and for the derivation of employment per $1 million of outlays, the total employment estimates and the time-phasing of the growth came from the payment schedule supplied by the NYCTA. That detailed projections could be made in this manner (using dollar expenditures) is significant in that it reduces the amount of proprietary information, such as detailed production schedules, which the firm must make available.

It is also true that more direct company data were needed in order to prepare the projections; however, this should not be viewed as a drawback. To the extent that firm cooperation can be elicited during the preparation of projections, their accuracy should be improved. In addition, early involvement and interest on the part of the company bodes well for the ultimate utilization of the projections in setting up training, recruitment, counselling and other manpower program responses.

APPENDIX II

SELECTING THE CONTRACTS FOR STUDY

The initial task of an operating Early Warning System is to identify suitable Federal awards for study. Federal agencies where procurements are likely to be of a magnitude that will generate measurable and significant job opportunities must be identified and contact with these agencies must be initiated to select specific awards worth examining in depth and to determine if the information and data are available for preparing projections of the manpower implications of these awards by occupation.

The procedures for identifying contract awards suitable for study involve a process by which the magnitudes of expenditures are examined by agency, by program, and finally by individual procurement in order to identify those awards which are large enough to have an impact on employment at the local level.

The initial review is designed to eliminate all agencies and programs which are of such small dimensions that they are not likely to generate major individual awards. The size of the agency program notwithstanding, it must generate individual procurements of a significant size. Moreover, regardless of the dollar size of the procurement, a large enough portion of the expenditures must be scheduled for a single plant or locality to have a measurable effect on the local work force. Additional criteria applied in selecting the contract awards for study must include: 1) that expenditures by fiscal or calendar year be large enough to have an employment impact; 2) that some minimum manpower information for the award be available; 3) that the future expenditures would generate a change in manpower requirements as compared with the current level of effort at the plant; and 4) that the data required for the preparation of projections of employment be available early enough to provide the lead time necessary for the preparation of the projections and the planning of appropriate manpower programs.

Selecting Contracts for Study. A review of the Federal budget can reveal agencies with contract or grant programs which are likely to make large individual awards. The initial review of the FY 1973 budget permitted the elimination of all those Federal activities involving small program levels which might otherwise have been of interest, such as the Federal Power Commission (total outlays of $23 million), the HEW health facilities construction program ($85 million) and the Veterans Administration hospital and facilities construction program ($101 million). Direct expenditures by the military on defense, international programs and general government operating expenses (including interest payments) were also excluded.

Of the remaining major programs identified in the FY 1973 budget, a number were excluded because the nature of the expenditure was such that it was unlikely to result in individual procurements of sufficient magnitude. These include: agricultural price support activities; rural housing and telephone loans; aid to elementary and secondary school districts; manpower training and employment services; college level student assistance; medicare; medicaid; social security and welfare payments; and veterans' compensation and pension payments.

Barring major new legislation, these agencies and programs need not be reviewed again by an operating Early Warning System and may be considered unsuitable for inclusion in any system which projects the employment impact of major Federal procurements.

The following programs appear to warrant consideration because their dollar magnitudes indicate that they could involve individual procurements of the required minimum size:

Agency and Program	Estimated Outlays in FY'73 (in millions)
Department of Transportation	$5,068
Highway improvement	1,634
Airway and airport improvement	390
Urban mass transit	
Department of Housing and Urban Development	1,000
Urban renewal	625
Model cities	
National Aeronautics and Space Administration	1,128
Earth orbital program	853
Space science and applications	
Environmental Protection Agency	1,100
Sewage plants and construction grants	
Tennessee Valley Authority	603
Capital outlay and inventory program	
Atomic Energy Commission	565
Development of nuclear reactors	505
Production of nuclear materials	
General Services Administration	194
Construction program	
Postal Service	
Construction program	
Department of the Interior	
Reclamation construction and rehabilitation program	277
Corps of Engineers	1,194
Civil works program	

Source: Budget of the United States Government, Fiscal Year 1973.

Having identified the programs which appeared suitable for study because of the nature and magnitude of their expenditures, contact was initiated with these agencies to determine whether or not they had made or planned large grants or contract awards. The highway improvement, urban renewal, model cities, TVA capital outlay and inventory, and reclamation and rehabilitation programs are not suitable candidates for an Early Warning System at this time for reasons described below:

1. Highway and airport improvement programs. The Department of Transportation highway improvement program is not suitable for an Early Warning System because of the procedures and practices followed by the Department in awarding contracts. Although the program is monumental in its size, individual highway construction awards are made for small sections of a total highway system. This results in a large number of small contracts in the $3-5 million category. Although an individual highway system may cost in the hundreds of millions of dollars, to follow up and project the employment generated by each of the awards would be too costly and inefficient for an Early Warning System.

Similarly, the airway and airport improvement program of the Department of Transportation does not normally fund major procurement awards. This program focusses on financing small-scale modernizations at a large number of sites throughout the country.

2. Urban renewal and model cities programs. Both these programs managed by the Department of Housing and Urban Development are large,

but the individual awards to any one community have never exceeded $60 million. The bulk of each award, in addition, is used for real estate purchases, administration, etc. It is unlikely, therefore, that these programs will result in procurements of manufactures or construction large enough to warrant their inclusion in an Early Warning System.

3. TVA capital outlay and inventory program. This Teneessee Valley Authority program is substantial, but all construction work constructed under this program is performed by TVA itself with its own employees. Small awards are made to subcontractors for specific plumbing, painting or other work, but these awards are not large enough to include in the Early Warning System. Purchases of equipment for new power plants are made by TVA and these may exceed $100 million. A check with TVA, however, reveals that the nature of the products needed for a power plant is such that a maximum of only about $10 million goes to any one establishment. For example, TVA power plants will require high pressure boilers, gauges, generating equipment, and electronic control devices, each of which will be manufactured at a different factory. Even where the prime contractors retain the bulk of the award, they distribute the work among several of their own plants, due to the variety of products to be manufactured. The employment generated at any one location, therefore, is too small to warrant study.

4. Land reclamation and rehabilitation program. Although the total annual expenditure for the program as a whole is almost $300 million, the land reclamation and rehabilitation program of the

Department of the Interior involves many individual awards. Moreover, each project covers such extended periods of time that the employment impact of any one award is not great enough to warrant inclusion in the Early Warning System.

Unless there are significant changes in the procurement practices of the four programs discussed above, they will not be suitable for an Early Warning System. Seven major Federal agencies, however, were found to make large awards (i.e., of about $100 million or more) either on a regular or occasional basis. The Urban Mass Transportation program, NASA programs, Environmental Protection Agency sewage treatment plant grant program, Atomic Energy Commission programs, the Corps of Engineers civil works program, the GSA construction program, and the Postal Service construction program are all suitable for the Early Warning System.

1. Urban Mass Transportation grants. Grants awarded to local transit authorities by the Urban Mass Transportation Administration of the Department of Transportation are occasionally in the $100 million category and result in contract awards by the local authority for the purchase of such items as subway cars and light rail vehicles. Contact with the UMTA on a regular basis will identify the recipient of the grant and the manufacturer who receives the contract for production. UMTA also can provide information on the location of the plant in which production will take place. Data are not available from UMTA on the employment generated by the contract, the delivery schedule, or subcontracting arrangements. UMTA, however, has shown a willingness to

use its offices to extract such information, if it exists, from the local agency receiving the grant.

2. NASA space programs. Aside from the Department of Defense, NASA is the most suitable Federal agency for inclusion in the Early Warning System. NASA maintains close control over all of its awards, similar to the control exercised by the Department of Defense. NASA maintains two Centers, one in Houston, Texas and one in Huntsville, Alabama, where engineering and management of its awards are centralized. Manning curves, manpower requirements per unit produced, and information on other work performed by the contractor, as well as details on subcontracts, location of production, etc., are produced by and/or available from NASA. Moreover, the fact that the program is massive, that it is long-range, and that it represents a major priority of the government makes the space program a prime candidate for the Early Warning System.

3. EPA sewage plant grant program. Although the Environmental Protection Agency waste water treatment plant grant program makes only modest awards to local water authorities for construction of sewage treatment plants and ancillary facilities, the total cost of such projects is occasionally in the $100 million category. A publication prepared on a regular basis by EPA lists each grant made, the grantee, and the size of the total project, and the size of the grant awarded. This "Project Register of Waste Water Treatment Construction Grants" can easily identify all projects being funded with Federal monies which meet the size criteria for inclusion in the Early Warning System. Few

awards which meet the size criteria will be identified in any one year, but the ease of identification makes this program suitable for inclusion in the Early Warning System.

4. AEC programs. The Atomic Energy Commission owns a large number of establishments which are operated by private corporations under contract to the AEC. Major improvements and operating budgets are awarded on a regular basis to these contractors. However, all of the improvements are awarded as special small contracts which do not warrant follow-up. The operating budgets are not likely to increase substantially in any one year and consequently are not suitable for an Early Warning System unless the Department of Labor is willing to respond to employment generated by turnover at these establishments. Turnover may account for several thousand workers nationally each year and complete data on the occupations involved, the locations of the jobs, etc., are maintained by the AEC. The ease of responding to these job opportunities may be of interest to DOL.

In the past AEC had entered into joint ventures with private utilities for the construction of nuclear electric power plants which cost in excess of $100 million. With the industry's acceptance of the technology involved, the AEC is turning from the construction of these plants to the development of new techniques in energy production. The major effort at present, and apparently for the foreseeable future, is in the development of the fast breeder reactor for electric power generation. The AEC has embarked on a joint venture with private utilities and manufacturers to design and test this new power source. This new technology is still in the design phase; however, with the urgency brought about by the energy crisis, the process is likely to be accelerated. Construction was originally slated to begin on the prototype in 1975. As the design proves successful, the AEC will undoubtedly return to joint ventures with utilities to stimulate the introduction of the new technology. This will surely generate massive investment by both AEC and the industry which would be most suitable for the Early Warning System.

5. Postal services. In the past few years the postal service has embarked on a major construction program which includes awards in the $100 million category for the construction of bulk mail handling facilities. Those presently under construction have already reached peak employment and were not candidates for this study, but those to be built in the future should be reviewed. This year the Corps of Engineers managed the postal construction program and information could be obtained through them. Beginning next year, however, the Postal Service intends to make other arrangements for the management of its construction program. At this time it is not known which agency will handle Postal Service construction awards, but the program is suitable for the Early Warning System.

6. Corps of Engineers civil works program. The size of the Corps of Engineers civil works activities ($1.2 billion in outlays in FY 1973) makes this program a prime candidate for the Early Warning System. Several other factors also make the program attractive. Most of the projects are multi-year (three to seven years), which means that

if an award is identified and included in the EWS at the time of contract signing, employment opportunities identified over the life of the contract would be substantial since: 1) the employment begins at zero; 2) employment may peak each year and then decline as the construction season ends, thus providing new job opportunities each year as replacements for those workers who do not return to the site the following season; and 3) different work skills are needed in different phases of the project. Also, because Corps projects are generally located in rural or low population areas, an increase in the construction work force may pose difficulties for the local labor market. Finally, the Davis-Bacon Act requires all construction contractors working on Federally funded projects to pay prevailing union wage scales and to report monthly on their work force in occupational detail. These factors make the jobs financially attractive and provide a substantial data base for making projections.

7. GSA construction program. The General Services Administration has embarked on a major construction program to reduce the backlog of projects for Federal office and other space. Under its new procedures, successful bidders will be required to provide their own financing for each project; this will relieve the limitations placed on new construction by GSA's annual budgets. This new approach will result in a substantial increase in new awards made each year. Almost all of GSA's awards are well below the $100 million level; however, GSA will occasionally contract for a major installation, such

as the FBI building or a complex of Federal buildings in an urban area. GSA, therefore, appears to meet the criteria for inclusion in the Early Warning System, although its procurements will not provide many cases for it.

From the procurement office in each of the seven agencies suitable for an Early Warning System, it is possible to identify all of the agency's procurements, and the size, the time frame, and the planned fiscal year appropriations required for each. Moreover, through the procurements officer it is possible to obtain information from the program staff on the manpower implications of each award. That is, the program staff, which is responsible for monitoring the performance of the contractor, was found in each case to be able to determine whether the new award would require more or less workers than the current level of work at the contractor's plant and whether the new award would require changes in the occupational profile of the work force. This information permits the identification of awards which will have significant manpower impacts at the local level. Although the program staff is not generally able to identify the numbers of workers needed in the particular occupations involved, the information it can supply is essential in determining the value of preparing projections for each individual procurement action. (A list of the appropriate contacts in each agency appears in Appendix III.)

APPENDIX III

DATA AND DATA SOURCES FOR THE THREE AGENCIES STUDIED

The following is a listing of the offices contacted for information in the various agencies studied, with names, addresses, and telephone numbers when available. A short description of the data obtained from each office is also presented.

Data and Data Sources for the Three Agencies Studied

Data Source	Data Obtained
CORPS OF ENGINEERS	
1. Civil Works Directorate Operations Division Construction Branch Richard M. Edwards, Chief Forestal Building, L'Enfant Plaza Washington, D.C. 693-6894	Anticipated appropriation levels for potential contracts for EWS investigation; type of work to be performed; likely manpower needs in general (increase or decrease from prior year)
2. Nashville District Office Construction Division A.C. Bogarty, Chief Nashville, Tennessee 37202 (615)749-5605	Projected monthly expenditures at Smithland; contractor's schedule; reasonable contract estimate; monthly work progress reports
3. Louisville District Office Chief of Construction Division Louisville, Kentucky (502)582-5623	Payrolls and monthly work progress reports for the Uniontown lock and dam from a work phase similar to the upcoming work at Smithland
NASA	
1. Office of Organization & Administration George Vecchett, Director of Procurement (Edmond Colden, Assistant) 600 Independence Avenue, S.W. Washington, D.C. 755-2255	Anticipated appropriation levels for NASA procurements and likely employment impact on firm
2. Division of Resource Analysis Thomas Newman, Director 400 Maryland Avenue, S.W. Washington, D.C. 755-3214	Historical data on man-years per $1 million of expenditures for NASA contractors; projected annual expenditures for shuttle program

Data Source	Data Obtained
3. Shuttle Program Office Joseph Martin, Director 600 Independence Avenue, S.W. Washington, D.C. 755-3188	Historical data on man-years per $1 million of expenditures on SSME; expected outlays for coming fiscal year
4. Marshall Space Flight Center Richard Cook, Deputy to Center Director Huntsville, Alabama 35812 (205)453-1919	Manning curves - manpower over time by broad work groups; company data on direct manpower needed for other Rocketdyne projects
5. Department of Labor Office of Federal Contract Compliance 601 D Street, N.W. Washington, D.C. 20004	Affirmative Action Plan for Rocketdyne - historical and anticipated employment by broad occupational groups; data on turnover by occupation

DEPARTMENT OF TRANSPORTATION,
URBAN MASS TRANSPORTATION ADMINISTRATION

Data Source	Data Obtained
1. Urban Mass Transportation Administration Office of Administration Program Administration Division Harriet Hawkins, Director 400 7th Street, S.W. Washington, D.C. 20590 426-4011	Identification of potential contracts/grants for study and appropriation levels; name and address of contractor
2. New York City Transit Authority Hyman Feldman, Director of New Car Procurement 370 Jay Street Brooklyn, New York 11201 (212)852-5064	Payment and delivery schedules; estimated value added for contract
3. Department of Labor Office of Federal Contract Compliance 601 D Street, N.W. Washington, D.C. 20004	Affirmative Action Plan for Pullman-Standard - historical employment by broad occupational groups